THE ROLE OF TECHNICAL INFORMATION IN U.S. COMPETITIVENESS WITH JAPAN

HEARINGS

BEFORE THE

SUBCOMMITTEE ON
SCIENCE, RESEARCH AND TECHNOLOGY

OF THE

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SCIENCE AND TECHNOLOGY
HOUSE OF REPRESENTATIVES

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THE ROLE OF TECHNICAL INFORMATION IN U.S. COMPETITIVENESS WITH JAPAN

WEDNESDAY, JUNE 26, 1985

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY,
Washington, DC.

The subcommittee met, pursuant to call, at 1:55 p.m., in room 2318, Rayburn House Office Building, Hon. Doug Walgren (chairman of the subcommittee) presiding.

Mr. WALGREN. I apologize to you all for the interruptions and the delayed start because just as our hearing time came, they called for a vote on the floor and it was followed by another. This one will be followed somewhat directly also by another vote, but I thought we could start and at least provide an opportunity for Senator Rockefeller, who is the lead-off witness in this hearing, to play his part.

Let me just, by way of introduction, say that this afternoon the Science, Research and Technology Subcommittee, begins 2 days of hearings on the "Role of Technical Information in United States Competitiveness with Japan."

In the past 10 years, Japan has made substantial advances in science and technology, and particularly in the area of computers, semiconductors, fiberoptics, and robotics. This dramatic change in Japan's competitive position in high technology is indicated by the expanding bilateral balance in trade with the United States, with, I am afraid, Japan being on the winning side.

The complexity of the Japanese language and difficulty in learning it is one reason that underlies a one-way information flow from the United States to Japan, with very little returning. There is an acute shortage of people who are literate, both in Japanese language and in scientific and technical fields in our society and we certainly need to be sensitive to ways to overcome this kind of cultural and language barrier.

In the next 2 days, the subcommittee plans to investigate what progress has been made since last year's hearings on the availability of Japanese scientific information in the United States and also to look at the comparative strength of the United States and Japan in selected high-technology fields.

This is an area of continual interest, I think, by and large, in various levels of the U.S. Government. There have been a number of symposiums held in this area: the MIT held a symposium in 1983; the subcommittee had hearings in 1984 on this subject; the Smithsonian Institute held a conference on technical translation in

February 1985; the Defense Department's Science Board reported on industry-to-industry cooperation in 1984; and a seminar has just been concluded at the National Bureau of Standards on the same subject. This is an area that is of real interest at the public policy level in our society. We hope we can make some progress with it and make a specific contribution.

With that, let me welcome Senator Rockefeller from West Virginia, who has been a sponsor of legislation on the Senate side. I apologize to you, Senator, for the delayed start in our hearing.

We are particularly pleased that you are here and hope that, with your interest on the Senate side and the interest of other members on this committee and elsewhere in the Congress that we can work on this area together and see some concrete results from it.

Welcome to the committee.

[The prepared opening statements of Mr. Walgren and Mr. Boehlert follow:]

OPENING STATEMENT OF HON. DOUG WALGREN, SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY, HEARING ON THE ROLE OF TECHNICAL INFORMATION IN U.S. COMPETITIVENESS WITH JAPAN, JUNE 26, 1985

This afternoon the Science, Research and Technology Subcommittee will begin two days of hearings on the Role of Technical Information in U.S. Competitiveness with Japan.

In the past ten years, Japan has made substantial advances in science and technology, particularly in such areas as computers, semiconductors, fiber optics, biotechnology, and robotics. This dramatic change in Japan's competitive position in high technology is indicated by its expanding bilateral balance in trade with the United States. From a deficit in 1968, Japan has moved to a record $3.36 billion trade surplus; in contrast, the United States is experiencing a $130 billion trade deficit.

At least part of Japan's economic success can be attributed to its active national effort to collect, translate and subsequently apply foreign scientific and technical information to meet its own needs. The United States does not have a similar coordinated effort on a national level. In short, our policy is "not to have a policy." If we are to remain internationally competitive, we must make an attempt to become internationally-minded and be aware of technological developments in other nations, particularly in Japan.

We can no longer afford to indulge in a "not invented here" reluctance to take advantage of valuable information that is available. The exchange of information between the U.S. and Japan is unbalanced because of our deficiencies in collecting it; there is no clearly defined U.S. Government policy or agency for monitoring scientific information.

In contrast, Japan has an efficient, well-coordinated networking system in place which is supported by the Japanese Government. The Japan Information Center of Science and Technology (JICST) is under control of the Science and Technology Agency Prime Minister's Office. There are over 5,000 scientists and engineers, actively engaged in scientific research throughout Japan who, process and abstract over 10,000 foreign and domestic journals, as well as technical reports, conference presentations, and patents.

The complexity of the Japanese language and difficulty in learning it is probably the biggest single reason why the information flow has been one way—to Japan. There is an acute shortage of people who are literate both in Japanese and in scientific and technical fields. We need to look at ways to overcome the language barrier.

In the next two days, the Subcommittee plans to investigate what progress has been made since last year's hearings on the Availability of Japanese Scientific Information in the Untied States, and also to look at the comparative strength of the United States and Japan in selected high technology fields.

The witnesses will be asked to comment on the comparative strength of the U.S. and Japan in selected technologies; on the role the Federal Government should play in improving U.S. efforts to keep current on Japanese development in high technology areas; actions needed to increase the acquisition, translation, and dissemination

of Japanese scientific and technical information; and on whether we need to establish a national policy for monitoring foreign scientific information.

We are especially pleased to welcome Senator John D. Rockefeller who will be our lead witness here this morning.

OPENING STATEMENT FOR HON. SHERWOOD L. BOEHLERT (R-NY), HEARING ON THE ROLE OF TECHNICAL INFORMATION IN U.S. COMPETITIVENESS WITH JAPAN, JUNE 26, 1985

Mr. Chairman and Members of the Subcommittee on Science, Research and Technology, I am anxious to hear from the distinguished list of witnesses before us today.

This is the third in a series of hearings scheduled by the subcommittee since the beginning of the 98th Congress to address the role of the Japanese research and development infrastructure on the international market. In conjunction with passage of legislation to provide protection for U.S. firms engaging in joint R&D efforts, we held hearings on June 29 and 30, 1983 entitled "Japanese Technological Advances and Possible United States Responses Using Research Joint Ventures."

Then on March 6 and 7, 1984, this subcommittee invited expert witnesses to testify on "The Availability of Japanese Scientific and Technical Information in the U.S."

Today's hearing is particularly timely, as it immediately follows a two-day Conference in Gaithersburg, Maryland sponsored by the National Bureau of Standards and the Institute of Electrical and Electronics Engineers.

It is also timely in lieu of recent figures published by the Department of Commerce on the growing U.S. trade deficit.

Given the subject matter of the next two days of hearings, I can not underscore enough what I believe to be one fundamental difference our U.S. industries are experiencing in the world market versus the situation even 5 years ago. That is, the U.S. can no longer assume that we will dominate in all fields. Foreign competition and the application of American sponsored research offshore is threatening to "beat the pants" off our firms.

Results of past hearings and conferences on the subject of Japanese translation have raised the point that while perhaps larger corporations have in place mechanisms for tracking progress of foreign competitors, small businesses lack such resources. In addition, while there appears to be a manpower shortage for trained and skilled translators in foreign languages, we need to emphasize more the ability of our U.S. scientists and engineers to comprehend the Japanese literature so that time and money are not spent translating useless information.

In addition, the commitment on the part of industry, professional societies and trade associations to a national translation effort must be pursued. Likewise, coordination of the several currently operating federal efforts in this area needs to be addressed.

Mr. Chairman, I would finally conclude that a clear statement of goals and status of our present resources must be fully appreciated before we can understand how the subcommittee can best proceed to address this crucial void in foreign technical information.

STATEMENT OF HON. JOHN D. ROCKEFELLER IV, A U.S. SENATOR FROM THE STATE OF WEST VIRGINIA

Senator ROCKEFELLER. Thank you, Mr. Chairman, very, very much.

I want to, incidentally, congratulate you for the entirely successful efforts that you have made in this past year on this matter. It did not ultimately work out, but certainly your leadership was crucial and I think that you clearly understand that we just have to keep working at this until one of these days, we succeed in it.

Obviously, I am very happy to be here—to be invited by you, in fact, which I consider to be a particular honor. I will admit to you that, compared to problems of the high-valued American dollar, which has been devastating to my part of the country, as well as to your part of the country, the subject of access to Japanese techni-

cal literature may seem like a small factor in the ability of our industries to compete. But I frankly view it as a very important aspect of the problem and certainly a highly symbolic one.

For years, the Japanese have undertaken vigorous efforts to learn all they could about our scientific research and discoveries. They have combed our professional journals; they have sent students to study in our universities; and because their educational system emphasizes the teaching of English, many of their brightest engineers and scientists are reasonably fluent in English.

They read our literature; they attend international meetings; and they consult with their counterparts in the United States about research and development. In contrast, however, American researchers and business people have far fewer opportunities to learn from the Japanese. We participate in bilateral scientific exchanges, but our companies know much less about Japanese research and technological development than the Japanese know about ours.

Secrecy on the part of the Japanese is not really the problem. The Japanese are prolific publishers. According to testimony before your subcommittee last year, Mr. Chairman, there are roughly 10,000 Japanese technical journals. In the absence of the language barrier, much Japanese R&D could be available to American companies, laboratories and universities. But as you have just indicated, very few Americans can read or speak Japanese and, frankly, I can testify to that somewhat directly. I spent 3 years at a university in Japan, 2½ of those in intensive Japanese language courses and another additional half-year living with a Japanese family that spoke no English whatsoever. Twenty years ago, I was reasonably fluent. Today I am more or less back to where I was at the beginning. It is a very tough language, as you have indicated, and very few of our people, much less our business people, can claim to have mastered it.

Americans also know very little about Japanese culture and very little about the Japanese way of doing business, both of which are quite different from our own. There are probably fewer students of Far Eastern culture now than when I was in college. That was in the 1950's. Japanese practices of cultivating business relationships slowly with great emphasis on personal service can be very bewildering to American companies. While our people are frequently in a hurry to wrap up a deal, the Japanese value repeated personal contacts and attention to detail. This process is called "tending roots," and it is symbolic of a cultural difference between our culture and theirs: and that is, before the bulb will sprout or the flower will grow, the roots underneath the earth, must be carefully tended to, nurtured. The Japanese approach business with the same intensive type of effort. That is their philosophic and cultural approach to life and, in my view, it has much to do with the way that the country has rebuilt its economy in the decades since the war.

A good example of this diligence in the area of technological development is the Japanese or the Japan external trade organization, JETRO, a public corporation set up in the 1950's to provide detailed information on market trends to Japanese businesses. It's

funded by the Japanese Government and JETRO functions, in a sense, like an economic CIA.

It has agents in over 60 foreign countries who track changes in tariffs and trade practices, product specifications and help with the marketing of Japanese products abroad. JETRO even follows the careers of researchers and business executives so that when they leave a particular company, the Japanese can hire them as consultants for debriefing, so to speak, on their work.

In the course of these efforts to learn from their competitors, the Japanese collect journals from all over the world. The material is screened; it is abstracted; indexed, translated where necessary, and distributed to Japanese researchers and business. An agency within the Japanese Prime Minister's Office, no less, the Japan Information Center of Science and Technology coordinates all this work; right out of the Japanese Prime Minister's Office! The systematic information-gathering has helped move Japan to the forefront of scientific research.

First, the Japanese prove expert at applying the research findings of others to the development of new products. For example, American discovered the transistor; while the Japanese produced the transistor radio. In recent years, Japanese applications of American inventions have focused on development of new processes like computer technology and robotics and things that you indicated in your opening statement, Mr. Chairman.

Earlier this year, the President's Commission on Industrial Competitiveness, which is a magnificent and much ignored piece of work, found the Japanese way ahead of us in the development of advanced manufacturing processes and technology. This report confirmed what analysts have long understood; that the United States excels in inventing; in developing new technology, but that somehow after that, the process breaks down. Quoting from that report, Mr. Chairman—

> It does us little good to design state of the art products if, within a short time, our foreign competitors can manufacture them more cheaply. . . Robotics, automation and statistical quality control were all developed in the U.S., but in recent years, they have been more effectively applied elsewhere. The Japanese have been most aggressive . . . and the results have often been lower cost and superior quality products.

The Japanese have also moved beyond adapting the work of others to become genuine first-class researchers and innovators. Japan now devotes over 2 percent of its gross national product to research and development and ranks third in spending for scientific and technical research.

Like the United States, Japan is engaged in path-breaking research in such fields as telecommunications equipment, biotechnology, robotics, fiberoptics and computer technology. It is really rather arrogant on our part, as a country, to act as if there is little that we can learn from Japan. At the very least, if our companies, scientists, and engineers had greater access to Japanese research and technical information, we would know more about the kinds of new technologies and products that will soon be competing with our own.

In this country, Mr. Chairman, we tend to think big and search for large-scale solutions to industrial problems. In contrast, the

Japanese approach to the competition, both at home and abroad, relies upon the tireless pursuit of many small efforts which eventually add up. I am not suggesting that we ought to forget the big picture or abandon efforts to adjust our macroeconomic policy or fight unfair trade practices, but at the same time, we should learn to pay attention to detail and learn from others, as the Japanese do.

Accordingly, the availability of Japanese research and technical information in the United States is one small step that we can take to compete more effectively. On May 6, Senator Baucus and I introduced a bill to encourage the translation and the distribution of Japanese scientific and engineering literature to American researchers and businesses. Our bill would earmark $500,000 within the Department of Commerce—not new money, but money already there—obviously not a lot of money, but enough, we hope, to get such an effort underway.

We anticipate a core staff at Commerce with input from potential users of the material arranging for the screening and the translation of Japanese professional journals, which would then be provided to users at cost. The Agency would also be responsible for publicizing the available material and serving as a clearinghouse for this kind of technical information.

Mr. Chairman, I am convinced this program can be implemented without duplicating the activities of other Government agencies or the private sector. At present, Federal civilian agencies do only a limited amount of Japanese translation. Military agencies, obviously, do more, but I don't think that is really what we are talking about here. Private services and trade associations are primarily involved in providing abstracts and indexes of Japanese technical material, rather than the full texts of a broad range of articles and reports.

Our bill, in my judgment, would help to address all of these deficiencies and provide access to potentially valuable information that is simply too costly for individual companies or laboratories to obtain on their own.

Mr. Chairman, in closing, let me say that few things make me or this committee and its chairman or the American people as alarmed as Japan's unfair trade practices. It is a long past time now, in my judgment, for this administration to get tough and get smart with Japan. We can no longer afford to let Japan flood our country with their goods while shutting American-made products out of the Japanese market.

But we should also recognize that unfair competition is not the whole story and complaining about it is certainly not the whole answer. There are a number of initiatives that we in this country should be taking to improve our competitive position, to get leaner, to get stronger, to get more self discipline. This legislation that I present, Mr. Chairman, is a good first step.

How can our businesses and scientists compete with the Japanese if they have access to our best scientific and technical data while we lack vital information about their technology? It doesn't make sense.

That is the kind of business help Government should provide. That is the kind of responsibility Government should assume. This

administration says that its goal is to get Government off the back of business. I say it is time to get Government on the side of business. Our Government should be doing what other Governments do for their people, helping their businesses and scientists to compete, working and fighting for the Nation's economic future.

I don't think that is too much to ask. Mr. Chairman, I commend you in particular, and your colleagues on this subcommittee for all the work that you have done on this subject, not only now, but in the recent years.

I look forward to working with you on what I consider to be an extremely critical, interesting and reasonably unknown area. I wish us both good luck.

[The prepared statement and biographical sketch of Senator Rockefeller follow:]

Statement of

THE HONORABLE JOHN D. ROCKEFELLER IV

Before the Subcommittee on Science, Research and Technology

Committee on Science and Technology

U.S. House of Representatives

Wednesday, June 26, 1985

I WELCOME THE OPPORTUNITY TO TESTIFY AT THESE HEARINGS AND BELIEVE THEY WILL HELP US UNDERSTAND WHY JAPAN HAS BECOME SUCH A FORMIDABLE COMPETITOR IN INDUSTRIES WE ONCE DOMINATED. COMPARED TO A PROBLEM LIKE THE HIGH DOLLAR, WHICH HAS BEEN PARTICULARLY DEVASTATING TO MAJOR SECTORS OF MY STATE'S ECONOMY, THE SUBJECT OF ACCESS TO JAPANESE TECHNICAL LITERATURE MAY SEEM LIKE A SMALL FACTOR IN THE ABILITY OF OUR INDUSTRIES TO COMPETE. BUT I VIEW IT AS AN IMPORTANT ASPECT OF THE PROBLEM, AND A HIGHLY SYMBOLIC ONE.

FOR YEARS, THE JAPANESE HAVE UNDERTAKEN VIGOROUS EFFORTS TO LEARN ALL THEY COULD ABOUT OUR SCIENTIFIC RESEARCH AND DISCOVERIES. THEY HAVE COMBED OUR PROFESSIONAL JOURNALS; THEY SEND STUDENTS TO STUDY IN OUR UNIVERSITIES. AND BECAUSE THEIR EDUCATIONAL SYSTEM EMPHASIZES THE TEACHING OF ENGLISH, MANY OF THEIR BRIGHTEST ENGINEERS AND SCIENTISTS ARE REASONABLY FLUENT. THEY CAN READ OUR LITERATURE; ATTEND INTERNATIONAL MEETINGS, AND CONSULT WITH THEIR COUNTERPARTS IN THE U.S. ABOUT RESEARCH AND DEVELOPMENT.

IN CONTRAST, AMERICAN RESEARCHERS AND BUSINESS PEOPLE HAVE FAR FEWER OPPORTUNITIES TO LEARN FROM THE JAPANESE. WE PARTICIPATE IN BILATERAL SCIENTIFIC EXCHANGE, BUT OUR COMPANIES KNOW MUCH LESS ABOUT JAPANESE RESEARCH AND TECHNOLOGICAL DEVELOPMENT THAN THE JAPANESE KNOW ABOUT OURS.

SECRECY ON THE PART OF THE JAPANESE IS NOT THE PROBLEM. THE JAPANESE ARE PROLIFIC PUBLISHERS: ACCORDING TO TESTIMONY BEFORE YOUR SUBCOMMITTEE LAST YEAR, THERE ARE ROUGHLY 10,000 JAPANESE TECHNICAL JOURNALS. IN THE ABSENCE OF THE LANGUAGE BARRIER, MUCH JAPANESE R&D COULD BE AVAILABLE TO AMERICAN COMPANIES, LABORATORIES, AND UNIVERSITIES.

BUT FEW AMERICANS CAN READ JAPANESE, AND I CAN TESTIFY--FROM PERSONAL EXPERIENCE--THAT IT IS A VERY DIFFICULT LANGUAGE TO LEARN. WHEN I MAJORED IN FAR EASTERN STUDIES AT COLLEGE, I STUDIED JAPANESE FOR TWO AND A HALF YEARS. I LIVED IN JAPAN FOR THREE YEARS--SIX MONTHS OF THE TIME WITH A FAMILY THAT SPOKE NO ENGLISH. FOR ALL OF THIS EXPOSURE TO THE LANGUAGE, I DON'T CLAIM TO HAVE FULLY MASTERED IT.

AMERICANS ALSO KNOW RELATIVELY LITTLE ABOUT JAPANESE CULTURE AND WAYS OF DOING BUSINESS, WHICH ARE QUITE DIFFERENT FROM OUR OWN. THERE ARE PROBABLY FEWER STUDENTS OF FAR EASTERN CULTURE NOW THAN WHEN I WAS IN COLLEGE. JAPANESE PRACTICES OF CULTIVATING BUSINESS RELATIONSHIPS SLOWLY--WITH GREAT EMPHASIS ON PERSONAL SERVICE--CAN BE PARTICULARLY BEWILDERING TO AMERICAN

COMPANIES. WHILE OUR PEOPLE ARE FREQUENTLY IN A HURRY TO WRAP UP A DEAL, THE JAPANESE VALUE REPEATED PERSONAL CONTACTS AND ATTENTION TO DETAIL. THIS PROCESS OF "TENDING ROOTS" IS CHARACTERISTIC OF MANY ASPECTS OF JAPANESE LIFE--AND, IN MY VIEW, HAS MUCH TO DO WITH THE WAY THE COUNTRY REBUILT ITS ECONOMY IN THE DECADES SINCE THE WAR.

A GOOD EXAMPLE OF THIS DILIGENCE IN THE AREA OF TECHNOLOGICAL DEVELOPMENT IS THE JAPAN EXTERNAL TRADE ORGANIZATION (JETRO), A PUBLIC CORPORATION SET UP IN THE 1950s TO PROVIDE DETAILED INFORMATION ON MARKET TRENDS TO JAPANESE BUSINESSES. FUNDED BY THE JAPANESE GOVERNMENT, JETRO FUNCTIONS LIKE AN "ECONOMIC CIA": IT HAS AGENTS IN OVER 60 FOREIGN COUNTRIES WHO TRACK CHANGES IN TARIFFS AND TRADE PRACTICES, PRODUCT SPECIFICATIONS, AND HELP WITH THE MARKETING OF JAPANESE PRODUCTS ABROAD. JETRO EVEN FOLLOWS THE CAREERS OF RESEARCHERS AND BUSINESS EXECUTIVES SO THAT, WHEN THEY LEAVE A PARTICULAR COMPANY, THE JAPANESE CAN HIRE THEM AS CONSULTANTS FOR "DEBRIEFING" ON THEIR WORK.

IN THE COURSE OF THESE EFFORTS TO LEARN FROM THEIR COMPETITORS, THE JAPANESE COLLECT JOURNALS FROM ALL OVER THE WORLD: MATERIAL IS SCREENED, ABSTRACTED, INDEXED, TRANSLATED (WHERE NECESSARY) AND DISTRIBUTED TO JAPANESE RESEARCHERS AND BUSINESSES. SINCE MUCH OF THIS AUDIENCE READS ENGLISH, THE NEED TO TRANSLATE AMERICAN PUBLICATIONS IS REDUCED SOMEWHAT. AN AGENCY WITHIN THE JAPANESE PRIME MINISTER'S OFFICE, THE JAPAN

INFORMATION CENTER OF SCIENCE AND TECHNOLOGY, COORDINATES THIS WORK.

THIS SYSTEMATIC INFORMATION-GATHERING HAS HELPED BRING JAPAN TO THE FOREFRONT OF SCIENTIFIC RESEARCH. FIRST, THE JAPANESE PROVED EXPERT AT APPLYING THE RESEARCH FINDINGS OF OTHERS TO THE DEVELOPMENT OF NEW PRODUCTS: AMERICANS DISCOVERED THE TRANSISTOR, FOR EXAMPLE, WHILE THE JAPANESE PRODUCED THE TRANSISTOR RADIO. IN RECENT YEARS, JAPANESE APPLICATIONS OF AMERICAN INVENTIONS HAVE FOCUSED MORE ON DEVELOPMENT OF NEW PROCESSES--LIKE COMPUTER TECHNOLOGY AND ROBOTICS--THAN NEW PRODUCTS.

EARLIER THIS YEAR, THE PRESIDENT'S COMMISSION ON INDUSTRIAL COMPETITIVENESS FOUND THE JAPANESE WAY AHEAD OF US IN THE DEVELOPMENT OF ADVANCED MANUFACTURING PROCESSES AND TECHNOLOGY. ITS REPORT CONFIRMED WHAT ANALYSTS HAVE LONG UNDERSTOOD: THAT THE UNITED STATES EXCELS IN INVENTING--IN DEVELOPING NEW TECHNOLOGY--BUT THAT SOMEHOW, AFTER THAT, THE PROCESS BREAKS DOWN.

QUOTING FROM THAT REPORT:

"IT DOES US LITTLE GOOD TO DESIGN STATE-OF-THE-ART PRODUCTS IF, WITHIN A SHORT TIME, OUR FOREIGN COMPETITORS CAN MANUFACTURE THEM MORE CHEAPLY... ROBOTICS, AUTOMATION, AND STATISTICAL QUALITY CONTROL WERE ALL DEVELOPED IN THE U.S.. BUT IN RECENT

YEARS THEY HAVE BEEN MORE EFFECTIVELY APPLIED ELSEWHERE. THE JAPANESE HAVE BEEN MOST AGGRESSIVE...AND THE RESULTS HAVE OFTEN BEEN LOWER COST AND SUPERIOR QUALITY PRODUCTS."

THE JAPANESE HAVE ALSO MOVED BEYOND ADAPTING THE WORK OF OTHERS, TO BECOME FIRST-CLASS RESEARCHERS AND INNOVATORS. JAPAN NOW DEVOTES OVER 2 PERCENT OF ITS GNP TO RESEARCH AND DEVELOPMENT AND RANKS THIRD IN SPENDING FOR SCIENTIFIC AND TECHNICAL RESEARCH, AFTER THE U.S. AND THE SOVIET UNION. LIKE THE U.S., JAPAN IS ENGAGED IN PATH-BREAKING RESEARCH IN SUCH FIELDS AS TELECOMMUNICATIONS EQUIPMENT, BIOTECHNOLOGY, ROBOTICS, FIBEROPTICS, AND COMPUTER TECHNOLOGY. IT IS REALLY RATHER ARROGANT ON OUR PART TO ACT AS IF THERE IS LITTLE WE CAN LEARN FROM JAPAN. AT THE VERY LEAST, IF OUR COMPANIES, SCIENTISTS, AND ENGINEERS HAD GREATER ACCESS TO JAPANESE RESEARCH AND TECHNICAL INFORMATION, WE'D KNOW MORE ABOUT THE KINDS OF NEW TECHNOLOGIES AND PRODUCTS THAT WILL SOON BE COMPETING WITH OUR OWN.

IN THIS COUNTRY, WE TEND TO "THINK BIG" AND SEARCH FOR LARGE-SALE SOLUTIONS TO INDUSTRIAL PROBLEMS. IN CONTRAST, THE JAPANESE APPROACH TO COMPETITION--BOTH AT HOME AND ABROAD--RELIES ON THE TIRELESS PURSUIT OF MANY SMALLER EFFORTS, WHICH EVENTUALLY ADD UP. I'M NOT SUGGESTING THAT WE FORGET THE BIG PICTURE--OR ABANDON EFFORTS TO ADJUST OUR MACROECONOMIC POLICIES OR FIGHT UNFAIR TRADE PRACTICES. BUT AT THE SAME TIME WE SHOULD LEARN TO PAY ATTENTION TO DETAIL--AND LEARN FROM OTHERS, AS THE JAPANESE DO.

INCREASING THE AVAILABILITY OF JAPANESE RESEARCH AND TECHNICAL INFORMATION IN THE U.S. IS ONE SMALL STEP WE CAN TAKE TO COMPETE MORE EFFECTIVELY. ON MAY 6, SENATOR BAUCUS AND I INTRODUCED A BILL (S. 1073) TO ENCOURAGE THE TRANSLATION AND DISTRIBUTION OF JAPANESE SCIENTIFIC AND ENGINEERING LITERATURE TO AMERICAN RESEARCHERS AND BUSINESSES.

-- OUR BILL WOULD EARMARK $500,000 WITHIN THE DEPARTMENT OF COMMERCE--OBVIOUSLY NOT A LOT OF MONEY, BUT ENOUGH, WE HOPE, TO GET SUCH AN EFFORT UNDERWAY. WE ANTICIPATE A CORE STAFF AT COMMERCE--WITH INPUT FROM POTENTIAL USERS OF THE MATERIAL--ARRANGING FOR THE SCREENING AND TRANSLATION OF JAPANESE PROFESSIONAL JOURNALS, WHICH WOULD THEN BE PROVIDED TO USERS AT COST. THE AGENCY WOULD ALSO BE RESPONSIBLE FOR PUBLICIZING THE AVAILABLE MATERIAL AND SERVING AS A CLEARINGHOUSE FOR THIS KIND OF TECHNICAL INFORMATION.

I'M CONVINCED THAT THIS PROGRAM CAN BE IMPLEMENTED WITHOUT DUPLICATING THE ACTIVITIES OF OTHER GOVERNMENT AGENCIES OR THE PRIVATE SECTOR. AT PRESENT, FEDERAL CIVILIAN AGENCIES DO ONLY A LIMITED AMOUNT OF JAPANESE TRANSLATION. MILITARY AGENCIES DO MORE, BUT I'D EXPECT THAT RELATIVELY LITTLE OF THE NON-CLASSIFIED MATERIAL TRANSLATED AT THE TAXPAYERS' EXPENSE FINDS ITS WAY TO AMERICAN BUSINESSES OR UNIVERSITIES. PRIVATE SERVICES AND TRADE ASSOCIATIONS ARE PRIMARILY INVOLVED IN PROVIDING ABSTRACTS AND INDEXES OF JAPANESE TECHNICAL MATERIAL, RATHER THAN FULL TEXTS OF A BROAD RANGE OF ARTICLES AND REPORTS. OUR BILL WOULD HELP TO

ADDRESS ALL OF THESE DEFICIENCIES, AND PROVIDE ACCESS TO POTENTIALLY VALUABLE INFORMATION THAT IS SIMPLY TOO COSTLY FOR INDIVIDUAL COMPANIES OR LABORATORIES TO OBTAIN ON THEIR OWN.

MR. CHAIRMAN, IN CLOSING LET ME SAY THAT FEW THINGS MAKE ME OR THIS COMMITTEE OR THE AMERICAN PEOPLE AS ALARMED AS JAPAN'S UNFAIR AND IRRESPONSIBLE TRADE PRACTICES. IT IS LONG PAST TIME, IN MY JUDGMENT, FOR THIS ADMINISTRATION TO GET TOUGH WITH JAPAN. WE CAN NO LONGER AFFORD TO LET JAPAN FLOOD OUR COUNTRY WITH THEIR GOODS WHILE SHUTTING AMERICAN-MADE PRODUCTS OUT OF THE JAPANESE MARKET.

BUT WE SHOULD RECOGNIZE THAT UNFAIR COMPETITION IS NOT THE WHOLE STORY, AND COMPLAINING ABOUT IT ISN'T THE WHOLE ANSWER.

THERE ARE A NUMBER OF INITIATIVES WE SHOULD BE TAKING AS A COUNTRY TO IMPROVE OUR COMPETITIVENESS. THIS LEGISLATION IS A GOOD FIRST STEP: HOW CAN OUR BUSINESSES AND SCIENTISTS COMPETE WITH THE JAPANESE, IF THEY HAVE ACCESS TO OUR BEST SCIENTIFIC AND TECHNICAL DATA, WHILE WE LACK VITAL INFORMATION ABOUT THEIR TECHNOLOGY? THAT'S THE KIND OF BUSINESS HELP GOVERNMENT SHOULD PROVIDE; THAT'S THE KIND OF RESPONSIBILITY GOVERNMENT SHOULD ASSUME.

THE ADMINISTRATION SAYS THAT ITS GOAL IS TO GET GOVERNMENT OFF THE BACK OF BUSINESS. I SAY IT'S TIME TO GET GOVERNMENT ON THE SIDE OF BUSINESS. OUR GOVERNMENT SHOULD BE DOING WHAT OTHER

GOVERNMENTS DO FOR THEIR PEOPLE: HELPING THEIR BUSINESSES AND SCIENTISTS TO COMPETE, WORKING AND FIGHTING FOR THE NATION'S ECONOMIC FUTURE.

MR. CHAIRMAN, I COMMEND YOU AND YOUR COLLEAGUES ON THIS SUB-COMMITTEE FOR HOLDING THESE HEARINGS. THE WORK OF YOUR SUBCOMMITTEE DURING THE LAST CONGRESS IDENTIFIED THE PROBLEMS WHICH OUR LEGISLATION ATTEMPTS TO ADDRESS. WE SHOULD LEARN A GREAT DEAL FROM THE PANELS THIS AFTERNOON AND TOMORROW ABOUT HOW U.S. ACCESS TO JAPANESE TECHNICAL LITERATURE CAN BE IMPROVED AND, IN TURN, CONTRIBUTE TO THE COMPETITIVENESS OF OUR INDUSTRIES. I WELCOME THE CHANCE TO PARTICIPATE AND LOOK FORWARD TO WORKING WITH YOU.

JOHN D. ROCKEFELLER IV

BORN: June 18, 1937, New York City

LEGAL RESIDENCE: 1515 Barberry Lane
Charleston, West Virginia

MARITAL STATUS: Married
Wife: Sharon Percy Rockefeller
Children: John (Jamie), Valerie,
Charles, Justin

RELIGIOUS AFFILIATION: Presbyterian

POLITICAL AFFILIATION: Democrat

ELECTED OFFICES:

1966 -- Elected to the West Virginia House of Delegates, representing Kanawha County

1968 -- Elected as Secretary of State

1976 -- Elected 29th Governor of the State of West Virginia

1980 -- Re-elected Governor of West Virginia

1984 -- Elected United States Senator, representing the State of West Virginia

OTHER PUBLIC SERVICE:

1964 -- VISTA worker in Emmons, West Virginia, as part of President Kennedy's Commission on Juvenile Delinquency and Youth Crime Program

1973 -- President of West Virginia Wesleyan College, Buckhannon, West Virginia

EDUCATION:

Graduated from Harvard University in 1961 with an A.B. Degree in Far Eastern Culture and History

Attended International Christian University in Tokyo, Japan (three years)

Studied at Yale University

Phillips Exeter Academy

HONORARY DEGREES:

Doctors of Law: West Virginia University
Marshall University
Davis and Elkins College
Dickinson College
University of Alabama
University of Cincinnati

Doctor of Humanities: West Virginia Institute of Technology

Doctor of Public Service: Salem College

OTHER HONORS:

1982 -- Man of the Year (Jewish National Fund)

1974 -- Listed in Time magazine's 200 Faces for the Future

1969 -- One of the Ten Outstanding Men of America (selected by the U.S. Jaycees)

ADDITIONAL ACCOMPLISHMENTS DURING GOVERNOR ROCKEFELLER'S ADMINISTRATION

* Formation of the West Virginia Coal Development Authority to market West Virginia coal and to streamline the regulatory process

* Formation of the Governor's Office of Economic and Community Development

* Created the Governor's Task Force on Drunk Driving

* Proposal and passage of legislation for health care cost containment

* Development of Emergency Medical Services ambulance award program

* Proposal and passage of legislation for utility rate reform

* Comprehensive education package

* Development of volunteer fire department program

* Establishment of the Golden Mountaineer Discount Club Program -- a statewide senior citizen program which allows discounts for senior citizens on a variety of goods and services. (The program currently has over 300,000 members and more than 3,000 participating merchants.

* Development of Governor's Emergency Employment Program, which provided up to 6,000 jobs for the unemployed in West Virginia who had exhausted their unemployment benefits.

Mr. WALGREN. Well, we certainly appreciate your encouragement on this side. It seems like $500,000 is such a small amount, but I know that we had trouble feeling we could come up with much more than that over here, and I am sure that you felt the same limits.

I guess the question I have is if all we have is $500,000, would it be best applied to a specific program to actually provide translations, and/or are there other ideas that we should be generating before we implement a specific program? I don't know the answer to that and maybe there isn't any answer to it.

I didn't have the cultural exposure or the ongoing involvement with the problem as you do, and I have to stop and wonder: If all I have is $500,000, is this what I should do? Perhaps you would like to ruminate on that with me. Are there other things that leap immediately to mind or are we still at the stage of trying to focus and develop a plan, rather than to implement a plan at this point?

Senator ROCKEFELLER. Mr. Chairman, I don't want to sound phonily erudite, but I remember a long time ago, I was on—let me call it the East Asian Institute at a university, at the time of the war in Vietnam and we were asking ourselves the question as to how this particular university could develop an understanding of the Vietnamese people.

What was concluded that even before we came to a position to be able to understand the people of Vietnam and their culture that we had to first understand China and even the Chinese language, from which the Vietnamese language comes, and the Chinese culture, from which the Vietnamese culture, in some degree, comes.

I only say that—and as a result, the Chinese program was expanded and the Vietnam program lagged. I say that only because I think that language, information, specific knowledge, cannot be substituted for. The answer to your question, yes, there certainly are other ways that $500,000 could be spent that would be helpful. There could be specific seminars for American executives, but it seems to me we need to get a process started. With $500,000, I think that is all we are talking about: the $750,000 that you included last year, which went all the way through Congress and was vetoed at the White House, is that much better.

I want to get a process started, with activity focused in the Department of Commerce. I don't even care which division it is in; I just want a commitment, a policy commitment, a direction from us, assented to by the White House, calling for this effort. And if that effort will begin, I think it will be fundamental; it will make a very large difference. And the answer will still be yes, there are many other things that we should be doing.

Mr. WALGREN. I see.

Let me ask Mr. Lundine if he would assume the chair, and I apologize for having to respond to the bells. We do appreciate your interest in this and hopefully we can get something coming out of the House.

Thanks for coming——

Senator ROCKEFELLER. Thank you, Mr. Chairman.

Mr. WALGREN [continuing]. To the hearing, and I know Mr. Lundine would like to carry on the exchange.

Mr. LUNDINE [presiding]. Senator, I apologize for being late. As you know, we are having a vote on the floor right now.

I do not have any questions. We thank you very much for your testimony and for your advocacy to promote a better understanding among American business, and for that matter, the public at large, of the Japanese technological base and how they think. We deeply appreciate your coming here. The subcommittee will take your testimony and use it as we best can in our advocacy.

Mr. Boehlert, you have no questions?

Thank you very much.

Senator ROCKEFELLER. Thank you, Mr. Chairman.

Mr. LUNDINE. I would like to now ask Pat Hill Hubbard, Gene Strull, Prof. Edward Daub, and George W. Rogers if they would come forward, please.

First, we would like to welcome you all. I believe that we have written testimony from all of you and it will, in its entirety, be made a part of the record. You can proceed as you wish.

We will start with Ms. Pat Hill Hubbard, vice president of engineering and technical education, American Electronics Association.

Welcome.

STATEMENTS OF PAT HILL HUBBARD, VICE PRESIDENT, ENGINEERING AND TECHNICAL EDUCATION, AMERICAN ELECTRONICS ASSOCIATION; GENE STRULL, GENERAL MANAGER, ADVANCED TECHNOLOGY DIVISION OF WESTINGHOUSE DEFENSE AND ELECTRONIC SYSTEMS CENTER, EDWARD E. DAUB, GENERAL ENGINEERING DEPARTMENT, UNIVERSITY OF WISCONSIN-MADISON, AND GEORGE W. ROGERS, JR., VICE CHAIRMAN, INFORMATION HANDLING COMMITTEE, INTELLIGENCE COMMUNITY STAFF

Ms. HUBBARD. Thank you.

I am pleased to have been invited to be here today to represent the American Electronics Association, AEA, and I would like to share with members of this subcommittee and this panel our concern from the perspective of a growing trade imbalance on the need for the United States to keep abreast of Japanese technology.

I would like to just briefly describe efforts that AEA, as an association, has taken toward this effort. I certainly am not going to read all of my testimony that I have given you.

I am vice president of AEA and I am also president of its Electronics Education Foundation and since the time of my last card, I have also assumed responsibility for AEA's State Government operations. I head a program nationally to try to increase the number of engineers and computer science graduates from our universities, particularly focused on the faculty shortage issue.

AEA's 2,700 members encompass all segments of the electronics industry. We represent manufacturers and suppliers of computers, telecommunications equipment, defense systems and products, instruments, software, R&D, office systems and so forth. Our membership includes companies of all sizes and it ranges from the very small start-ups to the largest companies.

Seventy-one percent of our members are what we call small business, having fewer than 250 employees. Our members in aggregate

represent about 66 percent of U.S.-based electronic sales worldwide. The electronics industry itself is the single largest manufacturing sector in the company—in the country. We employ 2.6 million employees and we have an annual payroll in excess of $66 billion.

Senator Rockefeller certainly put a framework around our feelings when he talked about the trade imbalance. Until recently, we are all aware that the United States has held an unchallenged leadership position in world trade and we are pretty proud to have been a part of that. That preeminence has been underpinned, I would suggest, singularly by high technology and certainly—well, not singularly, agriculture certainly has been a bright spot as well.

We are concerned because our trade position has declined. It is an alarming decline. It has always been other industries who have been part of the deficit, not us. It is a little bit hard to recognize that.

We went from worldwide positive trade position of $9 billion in 1975 to the current $103 billion worldwide deficit. If you look at Japan, they ended last year with a $31 billion surplus just from the United State alone. So that $31 billion surplus in December has now climbed in 6 months to $40 billion and it is expected to go to $50 billion in December.

Mr. LUNDINE. Excuse me.

Ms. HUBBARD. Yes.

Mr. LUNDINE. Is that in electronics alone?

Ms. HUBBARD. The $50 billion that is anticipated in December is all United State-Japan trade, not just electronics.

Mr. LUNDINE. The other numbers you gave were also for all——

Ms. HUBBARD. All—exactly. Now, if you focus on the United State-Japan trade in electronics-based product, you do see, unfortunately, a major source of the imbalance. The United States electronics deficit with Japan is expected to be $20 billion of that $50 billion by the end of 1985.

Japan is certainly the free world's Far East cornerstone and our very strong ally in any threat to world peace, but we have to say in the trade arena, they are outpacing us and we are—we are greatly concerned.

They have many trade advantages. Some of them have already been mentioned here. They have a very literate work force, some say as high as 99 percent. Well, I am not sure anyone has 99 percent of anything, but that literate trade work force allows them to retrain, to regroup and to refocus quickly. They have a very strong work ethic and company loyalty that translates into high productivity. They have half the labor costs that we do. Their cost of capital is two to three times less that of the United States, which allows me to emphasize the need for Congress to deal with our budget deficit. That certainly relates to the cost of capital in the country. They have a very ready availability of capital through banks and their government policies reinforce their economic goals.

Two of the issues I would like to focus on just briefly in relation to this topic. One is they have a strong commitment to engineering education. With half the U.S. population, last year they produced 10 percent more bachelor degree EE—engineering graduates. In 1967, they outpassed us in BS engineering graduates and they have continued to do so ever since.

The second area I would like to emphasize is the access to U.S. technology. We have, as Senator Rockefeller pointed out, successfully promulgated the idea that English is the international language of research. The Japanese require 6 years of English in their high schools and if one goes on to college, another 12 credit hours. They speak English and they send their engineering students to the U.S. universities.

Last year, over 1,000 Japanese students were studying engineering in United States universities, however, in each of the last 20 years, no more than 7 United States students studied engineering in their universities.

As U.S. alumni, they invest in university-based research. The Japanese pour money into United States engineering schools. We are certainly pleased at the strength of those dollars because they are greatly needed by the infrastructure of the engineering schools. They have become a major market for licensing U.S.-developed technology in universities and we believe it is important to keep our universities open to all students.

We benefit greatly when foreign graduates return home. They are studied in our technology; they become employees of our foreign subsidiaries; they initiate trade licensing agreements with us and so forth. We believe strongly in keeping that open.

It simply becomes a matter of equity and traditionally, Japan has emphasized quality reliability in its products. It has looked to other nations, and especially the United States, for products to duplicate or to improve. The issue is that Japan is changing its role from a technological follower to a technological leader.

Even by 1981, Japanese R&D spending was $26 billion, some four times that of a previous decade and if you take that on a per-capita basis, that is equal to the United States' $52 billion in civilian R&D. Moreover, the Japanese Government supports only 25 percent of R&D, but only 2 percent of that is spent for defense.

The United States Government, while it supports twice as much R&D as Japan, spends 70 percent of that for defense.

R&D investment is directly related to Japanese trade success. We know that we are being overtaken in many important areas. Again, the Senator mentioned some of those, advanced ceramics, optical fibers, large-scale IC's, and I just read the other day that the Japanese have captured 17 percent of the United States microchip market.

Since a decade ago, the Japanese have been selling us more technology than we them. They hold 40 percent of all patents worldwide, four times what we do.

OK, how is AEA handling all of this? We are not just complaining; we are trying to respond. I would like to just tell you briefly about it. To assist our United States companies to garner a more equitable share of the Japanese market, with funding assistance, I am pleased to say, from the United States Department of Commerce, we opened a trade office in Tokyo last summer.

We have many services there, but one of them, in particular, is to become a resource for technical information to assist our companies. While the need clearly exists for the Japanese doors to open to United States imports, we believe it incumbent upon United States industry to walk through them as they are opened with an

understanding of the culture and an interest in designing for the markets abroad.

Prime Minister Nakasone recently chided United States businessmen for not trying hard enough, he said, to sell in Japan. He said, and I quote: "All Japanese businessmen in America speak English, but no American businessmen in Japan speak Spanish, do they?"

Our Tokyo office has established a comprehensive central library for U.S. companies and I am pleased to say since their opening, over 500 companies have used this office, both the large and the small and some Government people. There is an incredible supply of information. There are 6 daily newspapers and approximately 30 monthly publications in Japan devoted just to the Japanese electronic industry, an overwhelming amount of information.

Unfortunately, our office estimates that only about 6 percent of that is in English. Where it does exist in English, it tends to be dated and general in nature.

You heard of the translation costs, the lack of technical people to translate and so forth. There certainly is an inequity, then, in our eyesight, compared to the Japanese in terms of technological breakthroughs.

We intend in the fall to produce a directory of all United States electronics companies in Japan and this is necessary for several reasons. One is that apparently no decent telephone book exists in Japan. It is pretty hard to go over and penetrate the market where you can't find where the companies are and who to do business with.

We have just published "Sources of Electronics Information in Japan," and at least it is a beginning effort to point to where one can begin to penetrate the information market there.

So the information is available; we just simply need the language capability to use it, and I would like to point out two types of language capability. One is we clearly need technical people who are capable of doing Japanese translation. Those are the kinds of skills needed by our technical researchers and by our market-watchers, if you will, to keep the industry abreast on current trends, design requirements and so forth. But another kind of Japanese language capability is market-based. It is a knowledge—a basic knowledge—not necessarily a fluency, but a basic knowledge of the culture and enough of a language capability to be able to interact with Japanese business as they do with us here.

This skill is really aimed at developing informal personal relationships that you can't pick up in books. We have a program—the AEA Fellowship Program, which we started last year—it is now in its second-year effort. It is mounted in cooperation with Japanese private industry. AEA runs it under its foundation. We have a counterpart organization—somewhat of a counterpart organization to one in Japan called Electronics Industries Association, Japan.

The whole aim here is to foster appreciation for the technological capabilities of both countries, and secondarily, AEA's interest is trying to improve U.S. understanding of the socioeconomic barriers to trade. Those are not always talked about.

What we do is we find U.S. engineering graduate students in engineering and computer science. We put them in intensive Japa-

nese language training. We couldn't find any who had the language training, so we put them in university programs, Cornell last year, Berkeley this year, the—language training is paid for by U.S. companies. Then, the host companies in Japan pick up the air fare; they pay for the dormitory, the room and board, a living stipend and they give them research internships in their laboratories.

This year, our students are going to Hitachi, Fujitsu, Sony, and NTT.

Those are small steps, and more need to be taken. One of the first Federal steps, as I just described, has already been taken by the Department of Commerce in helping us to set up the office over there and in helping us to develop a model for this fellowship. We have also proposed to NSF to provide a challenge grant to us to match dollar for dollar industry moneys raised for the fellowship program and I might just comment, since there was a question about $500,000. Our program last year, we had 6 students—I wish there were 600, but it was 6, and it cost us $26,000. This year, we have another five to six and we have raised $40,000. It doesn't mean that the costs are going up; it just means that there is more support available. So the amount of money that is needed for innovative programs is not so great as targeting, I think, the right directions.

I would suggest—we suggest, as an association, a need to develop a national consensus that Japanese language training for engineers and technical people is important, and out of that public policy position are likely to flow many, many different creative ideas. I don't think it behooves me to suggest too many specifics on those, but we certainly, as an association, are interested in the subject and would like to support any thoughts that you have that you need help from private industry on.

Thank you.

[The prepared statement and biographical sketch of Ms. Hubbard follow:]

Role of Technical Information in U.S. Competitiveness with Japan -- AEA's Perspective

Testimony Presented to the

Committee on Science and Technology

Subcommittee on Science, Research and Technology

U.S. House of Representatives

June 26, 1985

Washington, D.C.

by

Pat Hill Hubbard

Vice President, Educational Policy and State Government Operations

President, Electronics Education Foundation

American Electronics Association

I am pleased to be here today representing the American Electronics Association (AEA). I would like to share with Members of subcommittee and this panel our concerns, from the perspective of a growing trade imbalance with Japan, on the need for the United States to keep abreast of Japanese technology. I would like to briefly describe efforts AEA has undertaken toward this end through its Japanese Fellowship Program and its Japanese trade office.

I am a vice president of AEA and president of its Electronics Education Foundation. I have responsibility for the Association's state government operations, guide AEA policy positions on federal and state legislative issues, and manage a

nationwide program dealing with universities, companies, and government bodies to improve the supply of engineers and technical professional graduates. I am here to provide the perspectives and recommendations of AEA as an organization on this important issue.

AEA's 2,700 member companies encompass all segments of the electronics industries, including manufacturers and suppliers of computers and peripherals, semiconductors and other components, telecommunications equipment, defense systems and products, instruments, software, research and office systems. The AEA membership includes companies of all sizes, from "start-ups" to the largest companies in the industry. The greatest number of the AEA membership (71%) are small companies employing fewer than 250 employees. AEA estimates that worldwide sales of U.S.-based electronics companies are $305 billion, and AEA member companies account for 66% of this total.

Not very long ago a billboard ad appeared alongside a Silicon Valley highway. Five or six Dodge Colt automobiles are shown lined up beneath a simple slogan: "Colt: All the Japanese you ever need to know."

I was struck by the irony of this ad. I had just finished reading Lee Iacocca's editorial calling on the federal government to deal with Japan's unfair trade advantages or else, he threatens, American industries will have to "relocate to foreign countries, or go out of business."

On an obvious level, Dodge/Chrysler's ad is paternalistically telling us not to worry about learning Japanese in order to compare the quality of foreign imports. "Trust us, your U.S. distributor. We have made the comparisons for you." Subliminally, however, the ad works to lull this country's growing awareness that perhaps we do need to understand the language of the Japanese, since their presence has become so pervasive in our economic lives.

The Japanese national policy is clearly focused on scientific and technological advancement. As a result, Japan is challenging the United States in the worldwide trade race.

U.S. Electronics Industry: Its Nature and Impact

Until recently, the United States held an unchallenged leadership position in world trade, underpinned by its preeminence in high technology.

U.S. based electronics companies, again, now have worldwide sales over $305 billion and domestic revenues of $225 billion. With an anticipated 15 percent annual revenue growth, electronics sales in the U.S. alone are expected to reach $500 billion by 1990. While today we are the sixth largest U.S. industry sector, by the turn of the century we expect to be second, behind energy. Electronics is already the largest single manufacturing segment in the United States today with an annual payroll in excess of

$65 billion. We currently employ 2.6 million Americans. In the next 15 years, the computer and peripheral equipment industry will become the fourth fastest growth industry in the country, creating 48.3 percent new jobs. In addition, our high technology industries produce the products, the technological tools, which all economic sectors--banks, automobile manufacturers, steel and oil companies, etc.--are using to increase their productivity and economic competitiveness.

However, there is currently a shift underway in the trade posture of our industry. While only four years ago, the U.S. electronics industries enjoyed a $6 billion surplus, in 1984 we had a deficit of $6.17 billion. For the first time, we are part of an unprecedented $123 billion worldwide U.S. trade deficit. And that deficit has tripled since 1982.

Japan, on the other hand, ended last year with a $31 billion surplus from the U.S. alone. Today it has climbed to $40 billion and is predicted to reach $50 billion by year's end. This is according to Lionel Olmer, outgoing Under Secretary of Commerce for International Trade. Japan's Research Institute on the National Economy projects the country's overall surplus over the next four years will total a whopping $455 billion.

When U.S.-Japan trade in electronics-based products is spotlighted, the major source of our growing imbalance blazes forth. The U.S. electronics deficit with Japan grew from almost $4 billion in 1980 to over $15 billion last year (See Attachment

A). It is expected to be $20 billion by the end of 1985.

Japan is the free world's far East cornerstone, a strong ally in any threat to world peace. Yet in the trade arena, as Julian Gresser, President of the East-Asian Consulting group recently commented, "The technological battle with the Japanese is really the industrial equivalent to the east-west arms race."

Japan Has Trade Advantages

Japan is well equipped to challenge all comers technologically. Its 99 percent literate workforce has a strong work ethic and company loyalty that generates high productivity. Its labor costs are 50 percent what ours are, and the cost of capital for electronics is two to three times less than in the United States. Other key trade advantages are:

- Ready Availability of Capital

Of the major industrialized nations, Japan has the highest rate of personal savings and capital formation. Unlike the U.S. where high tech companies generally rely on public stock offerings and venture capital, Japan's equity financing comes from banks. Of the 30 largest banks in the world, in fact, 11 are Japanese.

- Government Policies Reinforce Economic Goals

Japan's national policies have long included economic goals. The

country's consensus approach to decision making creates an environment in which industry interacts with rather than reacts to government, as in the U.S. Interaction creates a strategy which targets and focuses national resources on winners. William Tanaka, in 1981 testimony before the Joint Subcommittee on Trade, Productivity, and Economic Growth, described it in the following manner:

> They [the Japanese] systematically allow their "sunset" industries to expire if they cannot compete. Protection in Japan is accorded to "sunrise," knowledge- and information-oriented industries. . . . And even once-favored industries are allowed to fail as the technological process of innovation moves on.

- Strong Commitment to Engineering Education

Since independence in 1951, Japan's emphasis has been on strengthening education's role to achieve economic success:

Engineering education has been emphasized. In 1982, with only one-half the U.S. population, Japan produced 10 percent more engineering graduates with bachelor degrees (BSEs). Japan surpassed us in BS graduates in 1967 and has continued to do so ever since.

Excluding foreign nationals from U.S. degree data, Japan now graduates over twice as many BSEs as the U.S. says Larry P.

Grayson of the National Institute for Education in a 1984 Engineering Education publication. We do outproduce Japan at the engineering Master's and doctoral degree levels. However, without foreign nationals in the U.S. degree pool, and combining all three degree levels, we still have significant shortfalls (see Attachment B).

- Access to U.S. Technology

As the technological world leader, we have successfully promulgated the idea that English is the international language of research. Japanese require six years of English language study prior to secondary school (high school) graduation and an additional 12 credits in college. Grayson points out that: "this major linguistic advancement over American counterparts" allows "them to read the literature of at least the English speaking countries." Even i the University of Tokyo library, less than half the books and publications are in Japanese or Chinese.

As U.S. alumni and investors in U.S. university-based research, the Japanese are pouring money into U.S. engineering schools. They have become a major market for licensing U.S. university developed technology. Through university affiliate programs and endowed chairs, etc., they get early access to U.S. technological developments.

It is important to keep our universities free and open to all

students. We benefit when foreign graduates return home. Studied in our technology, they become employees of our foreign subsidiaries, initiate trade licensing agreements with us, etc.

It becomes simply a matter of equity. Almost all of Japan's engineering students are citizens. Yet in 1982-83, 1,097 Japanese were engineering students studying in the United States; of these 316 were electrical engineering (EE) majors. Only a dribble of American engineering students have ever studied in Japanese universities. According to Grayson, "In the last 20 years, not more than seven Americans were enrolled in Japanese engineering programs in any one year, and for most years there were none."

- Japan Moves to Technological Leadership Role

Traditionally Japan has emphasized quality and reliability in its products. It has looked to other nations, especially the United States, for products to duplicate or to improve. Today, Japan is changing roles. It is moving from a technological follower to a technological leader.

Even by 1981 Japanese R&D spending was $26 billion--some four times that of the previous decade. On a per capita basis, this is equal to the U.S.'s $52 billion civilian R&D investment. Moreover, the Japanese government supports 25 percent of R&D, with only 4 percent spent for defense. The U.S. government, however, while it supports twice as much R&D, spends 70 percent

for defense.

R&D investment is fostering Japanese trade success. An American Chamber study in Tokyo found that U.S. technology was being overtaken in 12 important areas, including advanced ceramics, optical fibers, and large scale integrated circuits. And since a decade ago, the Japanese have been selling us more technology than we them. As Dr. James Bartholomew of Ohio State University told this subcommittee last year, they hold 40 percent of all patents worldwide--four times the U.S. filings. The National Superspeed Computer Project and the Fifth-Generation "Thinking" Computer Systems Project are well-known efforts by Japan to take the technological lead.

"Through a Glass Darkly"--U.S. Scientific Myopia

In spite of the view of some that technical information exchange at the governmental level between the U.S. and Japan remains steady, growing evidence points to the contrary in the area of industrial information.

First, the good news: there are over 6 daily newspapers and approximately 30 monthly publications devoted strictly to the Japanese electronics industry. In addition, new publications are a constant, on-going source. An excellent place to find these is the Japanese Government Printing Office Bookstore. The Japanese government also maintains two large organs to categorize and assist the process. These are JICST and JOIS. JICST stands for

Japan Information Center for Science and Technology. Accordingly, JICST maintains a huge library, reference system and data base. JOIS is Japan Organization for Information Science. JOIS offers users access to a data base of every scientific/technological article published in Japan. JOIS also offers users access to other databases outside of Japan, such as DIALOG or MEDLINE in the U.S.

Now for the bad news: a good deal of this information is available only in Japanese. While translations into English do exist, they tend to be dated, general in nature and representative of a rather small percentage of the information available.

Dr. Bartholomew stated that only 25 percent of Japan's some 10,000 technical journals and literature now appear in English. Our AEA Tokyo office staff estimates this to be 6 percent. Further, current translation costs, ranging from $ .10 to $ .25 a word, make prices exorbitant. And adding to this expense is a dearth of language experts with the technical backgrounds to competently translate technical material when it is accessible. This makes U.S. sight of Japanese technological breakthroughs almost predestined to dim in comparison to the constancy of the clear 20-20 vision of our Japanese trading partners.

While the need clearly exists for opening Japanese doors to U.S. imports, it is incumbent upon U.S. industry to walk through them as they are opened, with an understanding of the culture in which

the markets exist. Prime Minister Yasuhiro Nakasone recently chided U.S. businessmen for not trying hard enough to sell in Japan.

The Prime Minister said, "All Japanese businessmen in America speak English. But, no American businessmen in Japan speak Japanese, do they?"

AEA--How We Are Responding

To assist U.S. firms to garner a more equitable share of the Japanese electronics market, AEA--with funding assistance from the U.S. Department of Commerce--opened a trade office in Tokyo last summer. Among other services, AEA/Tokyo is a resource for technical information to assist companies to design and manufacture competitive products for the Japanese marketplace.

The AEA/Tokyo office has quickly established a central library for U.S. companies in Japan. In addition to all of the publications and periodicals mentioned above, the AEA library receives nearly 30 monthly newsletters on U.S.-Japan electronics. It also maintains a comprehensive selection of books, journals, surveys, directories and marketing studies. Frequent users include large and small U.S. companies, as well as U.S. government personnel.

In addition to the central library, AEA Japan put together and published "Sources of Electronics Information in Japan." This

one-of-a-kind reference book identifies the most useful and valuable sources of information on the Japanese electronics industry - sources ranging from Japanese trade organizations, data banks, and technical journals to government publications, research labs and trade fairs. The book describes each source, gives addresses, prices, and commentary.

Also in our Tokyo office we have a project on going to identify the U.S.-affiliated community of companies in Tokyo. We have inaugurated an organization for those companies to communicate better with one another, in order to gain representation as an industry segment and to improve their collective means of expression.

A future aspect of this is to produce a directory of all U.S. electronics companies in Japan. AEA, as well as the organization of U.S. firms in Japan, are very excited about this project for a number of reasons. One is that it will provide a telephone book of firms to do business with in Japan.

Clearly the information is available and there for the using. But, again, we must have the language capability to use it. I have referred to our Japan Fellows Program as established in February of 1984. These students are the vanguard of a realization that the next generation of high tech professionals must have a capacity for fluency in Japanese. The AEA Japan Graduate Fellowship Program now entering a second year, is mounted in cooperation with Japanese private industry and the

Electronics Industries Association of Japan. AEA administers it under its Electronics Education Foundation. The program's goal is to foster development of a mutual appreciation of the technological capabilities of both countries. The approach is to increase numbers of U.S. graduate electrical and computer engineering and computer science students who have knowledge and sensitivity to Japanese language and culture and firsthand experience in Japanese company research laboratories.

We became aware of the early leadership efforts to achieve the same goal by Dick Samuels of MIT and Sam Coleman of North Carolina State, and of the special interest in the subject by Susan Goldman of New York University and Jeffrey Frey of Cornell.

Our program design is to send U.S. graduate students to Japan for up to a year to do research in company labs. We wrestled immediately with whether or not they needed to have Japanese language capability. Our Japanese industry friends assured us it was not necessary, since English is spoken in their laboratories. And some of our AEA company executives were of the same mind.

Yet we did not intend these students to live like expatriates. They would live like Japanese workers--housed in company dorms and fed at company cafeterias. Also, we recognized that the informal network of relationships they would build with their Japanese co-workers off the job would form the long-term technical communication links for the future. While we did not see it as necessary for them to be fluent in reading or writing

or be able to translate, we stood fast in our thinking that they should at least have some speaking and reading facility. Some Japanese language study would help them while they were in Japan as well as establish a base on which they can continue coursework at a late date.

Unlike a single university which generally must draw from matriculated students, NSA as a national organization was free to draw from many universities. We initially thought that from a graduate student universe in our targeted fields of some 26,000 students, we would find some Issei or Nissei with native-speaking ability or appropriate technical students who had taken Japanese courses. We were naive! We searched through Japan Societies and at universities with well-reputed Asian language programs. We found at the universities either no graduate engineering departments or the absence of any technical students meeting our criteria who could speak Japanese.

We found that the most salient reasons for engineering students--especially at the graduate level--to avoid Japanese programs on their campuses are:

(1) Japanese language classes are geared to language majors, held one hour a day, four days a week, etc., and conflict with research schedules of engineering majors.

(2) Japanese class content is geared to art, history, and literature and has little relevance to the interests of technical

students.

(3) The heavy academic and research demands on engineering graduate students for upwards of two years for a master's degree and five to six for a Ph.D. do not allow space for any serious language study.

We decided, therefore, to find an intensive summer language program to which we could send our students as a group. This offered the opportunity of supplementing language study with Saturday seminars on cultural and technical topics of interest. Last year we selected Cornell University, and with Eleanor Jorden and Jeff Frey's help, our six students all passed the course. Jeff, acting as AtA's Japan on-site coordinator, accompanied five of the students to Japan last fall. Two have already returned, three are still there. One student went this May.

The feedback on the usefulness of their language study is unanimously positive. One student, Doug Browning, states it well:

"As I suspected would be the case, the language program has proven to be invaluable. It is perhaps possible to survive here without knowing Japanese, so many people at the office speak English well and almost all read it; but when I think of the lost opportunities for interaction with the Japanese people both in the office and elsewhere from knowing no Japanese it makes me cringe."

This summer we have five more students and have enrolled them in University of California Berkeley's summer Japanese Language program. They will go to Japan in the fall to work in Sony, Fujitsu, Hitachi, and MIT research labs.

Other High Tech Perspectives on Language

It is important to point out that, while most member companies are enthusiastic about our fellowship program--some 19 supported the language study with hard dollars in 1984 and 1985--mixed perspectives exist on the usefulness of Japanese for technical employees.

We recently completed a survey to quantify the language needs of some of our members doing business in Japan. Thirty-four or 49 percent of those companies receiving questionnaires responded. Some highlights of the responses:

o Types of Business Operations in Japan

- 76% sales and service
- 35% engineering
- 26% manufacturing
- 15% regional headquarters
- 6% R&D or Procurement

o Number of U.S. Citizens at Japan Operations

Of the 6,317 combined numbers of workers at the 34

reporting companies, each has on average only 1 to 2 U.S. citizens in company employee populations that average 97 workers.

o Need for Japanese Language Training

- 40% reported never a need
- 47% reported sometimes or infrequently a need
- 13% reported often a need
- 1 company reported a need in the future

o Level of Need

Of those 60 percent who see a need for language training, 89 percent see minimal to fluent speaking capability as necessary. The next highest need is for reading, expressed by 63 percent. A need for technical vocabulary was reported by 58 percent.

While 58 percent see no need to learn to write and 63 percent no need to translate, 16 percent feel it necessary to be fluent in writing and 26 percent to be fluent in translation capability.

o Problems in Getting Japanese Language Training

Problems identified by respondents in order of those most frequently mentioned:

(1) Finding competent instructors
(2) Expense
(3) Time-consuming/impact on work schedules

(4) Convincing domestic managers worth time/cost

(5) Inconveniently scheduled local classes

No Japanese language preparation is provided by 55 percent for their workers in Japan. Of those who do provide it, 18 percent study with private language training institutes (most common is Berlitz), 12 percent offer employees courses in Japan with private tutors or through local language schools. Fifty-three employees from 23 companies took some form of Japanese language training in 1984.

o Additional Comments

- In keeping with a traditional worldwide perspective on staffing foreign subsidiaries, we hire locals to conduct our business. We hire only Japanese in Japan.
- It is more important to know how the Japanese do business, how to negotiate with them, Japanese pricing policies, and cultural aspects of doing business in Japan.
- The biggest problem we face is getting English training for Japanese employees.
- We could use Japanese training for U.S. employees here who interact with Japanese as well as for travel in Japan.

One company executive in a personal interview gave extensive comments (See Attachment C).

No other electronics trade association or research group has

activities currently to equip technical professionals with Japanese language training.

The Austin-based MCC anticipates in the future that 20 of their technical researchers will need training in speaking and reading Japanese. They currently employ two U.S. citizens to translate technical journals and articles. They contract with outside translators as well but find it time-consuming, expensive, and hard to locate ones with technical backgrounds. They stated, by the way, that only five-to-ten percent of all Japanese technical journals are currently translated.

Efforts on a larger scale than this are needed.

Steps to be Taken

One of the first federal steps has already been taken by the Department of Commerce in helping us to develop a model through partial financial support of our Japan coordinator. We have also proposed to the National Science Foundation that they provide a "challenge grant" to AEA's foundation to match dollar-for-dollar monies raised from private industry for our fellowship program's summer language component.

Further than our program needs, however, we need to develop a national consensus that Japanese language training for engineers and technical people is important. Out of that public policy position may come many creative ideas. One, suggested by an AEA

member, is to establish a Federal Center for Japanese Science and Technology. Similar to the training for diplomats offered by the Foreign Service Institute, this new Center could translate technical journals. It could offer Japanese language study geared to engineering and technical people. It could provide funds and/or technical assistance to selected university language departments which can design and offer special classes for engineering students.

The need is growing. The Federal role is less one of dollars than leadership.

Attachment A

ELECTRONICS TRADE WORLDWIDE

YEAR	IMPORTS	EXPORTS	BALANCE OF TRADE
1980	$15.5 billion	$21.8 billion	+ $6.3 billion*
1981	$19.2 billion	$24 billion	+ $4.8 billion*
1982	$21.4 billion	$24.9 billion	+ $3.5 billion*
1983	$26.7 billion	$26.8 billion	+ $100 million**
1984	n/a	n/a	- $ 7 billion**

Source: *AEA
**U.S. Department of Commerce

U.S. Trade with Japan in Electronics-Based Products 1980-1984 (In Millions of Current Dollars)

	1980	1981	1982	1983	1984
Consumer Products					
Exports:	62	50	37	33	35
Imports:	2,337	3,646	3,410	3,985	6,040
Deficit:	-$2,275	-$3,596	-$3,373	-$3,952	-$6,005
Industrial Electronics					
Exports:	1,562	1,802	1,904	2,154	2,639
Imports:	3,136	4,240	5,109	7,197	12,082
	-$1,574	-$2,438	-$3,205	-$5,043	-$9,443
Total Products					
Deficit:	-$3,849	-$6,034	-$6,578	-$8,995	-$15,498

Source: U.S. Department of Commerce
International Trade Administration,
Trade Development, Science and
Electronics Sector

Attachment B

COMPARISONS OF ENGINEERING DEGREES U.S. AND JAPAN

Engineering Degrees Produced 1962:

Degree Level	Japan*	U.S. Less Foreign Students' Degrees	Difference
Bachelor	73,593	61,580	-12,013
Masters	7,363	13,073	+ 5,710
Doctorate	621	1,720	+ 1,099
			5,204**

**U.S. produced 5,204 fewer non-foreign engineering students at all degree levels combined than Japan.

Electrical Engineering Degrees Produced 1962:

Degree Level	Japan*	U.S. Less Foreign Students' Degrees	Difference
Bachelor	19,429	14,758	- 4,671
Masters	1,671	3,089	+ 1,418
Doctorate	132	229	+ 188
			3,065**

**U.S. produced 3,065 fewer non-foreign electrical engineering students at all degree levels combined than Japan.

*Japan engineering students are almost all citizens.

Attachment C

Comments from Personal Interview with George Scalise, Senior Vice President and Chief Administration Officer, Advanced Micro Devices, on Need for Japanese Language Training for Engineers and Technical People, Santa Clara, California, January 4, 1984:

The U.S. Government has concluded that it is not important we know the Japanese language. This is the reverse from the Japanese, who believe it extremely important that their scientists and engineers learn English. The United States has become convinced that English is the international language. This has been fostered by many countries and by specific examples such as the International Transportation System, which requires that all pilots and controllers learn English. English's use internationally is borne out in so many ways that the United States population has become lazy about over-adopting this position.

Such attitudes are detrimental. If our chief competitor is Japan, and if Japanese can readily understand and participate in all U.S. technical symposia, but the U.S. cannot participate in any of the Japanese ones, this gives the Japanese a decided trade advantage.

The solution is to encourage broader educational programs for engineering students. Some form of foreign language--hopefully Japanese--for two years or more should be a requirement for engineering students. High schools, which now commonly teach French, Spanish, and German, rarely teach Japanese. Post-secondary eduction, therefore, becomes the college of last resort to learn the language. This is extremely important for engineers, although we also need plant managers and financial people who can speak and understand Japanese. As a company in Japan grows, it is even feasible that the personnel person would be a U.S. citizen.

Basically, an engineering graduate who has "special skill" in understanding and speaking Japanese is eminently more hireable than one without.

Companies are accommodating to the need. One way is by having key people in Japanese subsidiaries be understudied by other bilingual technical people. This avoids management problems related to language in the case of employee turnover. If a company gets caught where it needs to replace someone in Japan but has no one who knows Japanese, they would likely approach the problem by taking a technically competent person and teaching them language rather than taking one who speaks it and try to instill them with technical capabilities.

While there is a need to raise the consciousness of the companies, the universities, and the students to the need to increase Japanese language training for engineers and other technical people, the role of the federal government should be to lead in raising the consciousness and using federal dollars to seed start-up efforts. It might, for example, focus dollars to develop teachers with the capability to teach Japanese language courses. It might, through NSF, fund pilot projects to teach engineering students the language--such as the AEA Japan Fellowship Program model.

RELEVANT BACKGROUND ON

Pat Hill Hubbard

As a vice president of the American Electronics Association (AEA), Pat manages the Association's State Government Operations Department. She also guides AEA policy positions on federal and state educational legislative issues and manages a nationwide program dealing with universities, companies, and government bodies to improve the supply of engineers and technical professional graduates.

She is the founder and president of the Association's Electronics Education Foundation and has organized some 10 regional or state committees of industry CEOs and raised over $7 million since 1982 to fund doctoral study for U.S. citizens who want to teach electrical/computer engineering or computer science. She developed and manages the Association's program in which U.S. engineering graduate students receive Japanese language training and are then sent to Japan to work in research labs for up to a year.

Other present positions:

- o Member, Board of Governors, California Community Colleges
- o Member, Engineering Advisory Board, U.C. Berkeley, Department of Engineering
- o Chair, Vocational Education Committee, Board of Governors, California Community Colleges
- o Member, Bay Area Council, Employment Training Forum
- o Member, Board of Trustees, EDUCOM

Former positions:

- o Chairman of the Board, Institute for Innovative and Applied Technology, San Francisco State University
- o University and community college educator and industry management trainer.

She holds a masters degree from Stanford University and is at doctoral dissertation level at the University of San Francisco.

Mr. LUNDINE. Thank you very much.

Now we would like to hear from Gene Strull, general manager of the advanced technology division of Westinghouse Defense and Electronics Systems Center.

Mr. Strull.

Dr. STRULL. Thank you very much; I am quite honored to be here.

The competitive challenges that the United States faces in her relationship with Japan are quite formidable. Senator Rockefeller gave them eloquently.

The challenges are also well described in the report of the President's Commission on Global Competitiveness, which he referenced, so I won't repeat those. I would like to talk mostly about technical information, but there are some corrolary factors that I would like to bring in.

I am going to stick to my area of expertise, silicon integrated circuits, GaAs technology, visible and infrared sensors, acoustics, acousto-optics and computers, but the remarks are gemane to much of the high technology field.

I believe the United States is ahead of the Japanese in most portions of these technologies. You can find individual companies in the United States that will lead anyone in Japan in all of these fields. However, while the Japanese, through MITI, share and cooperate in research and development and save their competition for manufacturing, the United States strives on competition from end to end.

I wouldn't advocate we change this structure, but the Japanese have a way to focus on a market and we really don't. To further put my comments in the proper framework, I would like to characterize my feeling of Japan versus the United States in high technology.

We tend to be innovative and entrepreneurial while the Japanese are much more structured in their decisionmaking. I have had some incredible war stories about trying to get a decision from a Japanese executive. Decisions I can make at my level. I talk to people three levels higher; they have to get consensus all the way up and all the way down. I worked over 2 years to get one simple answer in one item.

In the strategy for high-technology markets, however, the Japanese have cooperation between management, labor, and Government and, unfortunately, Senator Rockefeller alluded to that, we tend to be passive at best.

Another basic difference between the two countries relates to obtaining capital. In Japan, older firms have very deep pockets with a much lower return on sales and investments, while in the United States, it is the new firms that attract the venture capital. A consequence of this difference is the result that all of the integrated circuit manufacturers in Japan are portions of major corporations, while in the United States, most of the merchant semiconductor manufacturers are new firms.

Right now, we are going through a worldwide downturn. I have heard Silicon Valley moan; I have heard the Japanese moan, but the Japanese firms has a huge cushion that our manufacturers don't have. This was well highlighted in the New York Times a

week and a half ago—June 16 in the Business Section—about this problem. There is also some information here on questionable pricing policies which—I will leave this because I think it is a subject of other committee membership.

In talking of market share, however, there is a significant point. The Japanese don't have 70 percent of the microchip market; they have 70 percent of the memory market. The issue of Fortune that came out this week discusses 'now, the Japanese challenge in microprocessor." They have had an inability to handle the microprocessor. This goes back to our innovation versus their consensus, which gives them, in particular, software problems.

I visted Japan several times since 1980, most recently in March of this year. I have met with most major electronic firms and have visited several areas of the country. Of the more 100 executives and technical personnel I have met, I can recall only one instance when a translator was needed.

The Japanese in the fields I have mentioned publish extensively in English, both in publications originating in Japan—Japan Semiconductor Technology is an excellent example, and in U.S. publications. The February issue of the IEEE Transactions on Electron Devices, a special issue on very large-scale integration, over 40 percent of the papers are from Japan.

Now, what does all of this mean? The term "high technology" is frequently used. Some people say everything in it is too high priced. My lay friends say everything I talk about is over their head, but the high in high technology really means high rate of change. We are currently in an era that never occurred before in history. Right now, the time between major block changes in a technology is shorter than the insertion time of that technology in a system.

The integrated circuit manufacturers went from 8-bit to 16-bit microprocessors faster than the computer manufacturers learned to use the 8-bit. So you are always behind. It is as though the Wright Brothers set out to build their airplane and before they got the engine mounted, they were handed a jet engine. So the real nub of what we are talking about is leadtime. Leadtime becomes of paramount importance.

In addition, integrated circuits are sufficiently complex that devices from different manufacturers that are supposed to be the same do not function exactly the same in all their parameters, particularly in the high-performance end of the spectrum. Thus, getting to the marketplace first, even if only by a few months, can lock in business for years because once a particular equipment manufacturer uses your device, it is very hard for him to change.

So, while we obtain in English most Japanese high-technology information, there is probably a lag of 6 months to 1 year, which is absolutely crucial in the high-tech marketplace.

Returning to the competitive strengths of the United States versus Japan, the United States continues to be a leader in innovation while the Japanese are ahead and increasing their lead in implementation.

I would like to deviate from technical information for just a moment. We must not take our leadership in innovation for granted. It is an edge we must maintain. The DOD Very High Speed In-

tegrated Circuit Program, VHSIC, which is so important to our defense posture, has also fallout which can help the integrated circuit industry and it has in process technology, design, test, and equipment. Similar initiatives in GaAs, advanced optics and artificial intelligence, just to mention a few, would seem worthy of consideration.

The Japanese are quite concerned about their lack of innovation. The National Science Foundation Tokyo office, in a memorandum dated April 5, 1985, had an editorial from the Mainichi Daily News. I just want to read a couple of sentences from that editorial.

> The Japanese enterprises, in the course of a shift from the development of science and technologies introduced from overseas to the development of independent technologies are in dire need of substantial basic studies.

So, to finish out this part of it, from my perspective, the problem of competitiveness is hardly related to any language barrier, at least as far as innovation is concerned. I don't think the R&D hurts us. However, the situation for implementation is totally different.

In the fabrication of integrated circuits, there are about 250 process specs with a number of subleties. Here is where the leadtime I mentioned is really important. There are technical meetings in Japan a significant time before the technical information reaches the United States. Even more important, the papers that reach interantional publications tend to be big picture, as compared to the specifics of device design and fabrication.

I have been in this field since 1951 and you have got to know when to kick the furnace, how far into the cycle, to get the product out and these never make it in an international publication.

It is the reason we visit Japan and the Japanese visit us. There are some vehicles for obtaining the information. Most U.S. firms involved in competition with Japan have offices in Japan which serve as vehicles for obtaining technical data.

How early the information is obtained is a very complex relationship. If you have a person in your office who has been there a while and has established all the contacts, he or she can really do wonders.

The Semiconductor Research Corp., has been taking advantage of the presence in Tokyo of Prof. Jeffrey Frey of Cornell University who is on a sabbatical at the University of Tokyo. He writes a "Frey Report from Japan" which is excellent. It is really exactly the sort of information that I think the committee is after and I will leave it.

[The information follows:]

SRC
COOPERATIVE RESEARCH

SEMICONDUCTOR RESEARCH CORPORATION

FREY REPORT FROM JAPAN
MAY, 1985

This is the fifth in a series of Newsletters by Professor Jeffrey Frey, an SRC Investigator at Cornell University who is spending a sabbatical at the University of Tokyo. Arrangements were made for Jeff to provide reports to the SRC about his visit in Japan. These Newsletters are being distributed to members of the Board of Directors and TAB.

A new MITI joint project on semiconductor production equipment was recently mentioned in an article in the March 1, 1985, issue of Electronic Business. The source of the information in the article was not MITI directly, but rather an analyst for Nomura Securities, Japan's biggest brokerage firm. This being an interesting item, I tried to obtain further information through the MITI public relations office, which is usually very helpful about official programs, at least; but they admitted to never having heard of this program. The person at Nomura mentioned in the article was very vague about details. From other sources, though, I did find out about what is happening with this "project."

It is true that MITI is currently receiving technical advice, from a university-affiliated individual, that it would be wise to institute a big joint research project on semiconductor production equipment--but specifically on production equipment for 0.25 micron devices. Equipment of interest would include that for etching, lithography, refractory-metal deposition, etc. Naturally, the proposed program would be a long-term one, and might be administered more like the current MITI New Devices project than the former VLSI joint laboratory or the current Fifth-Generation Computer project. In other words, rather than building central facilities to which individual companies would send workers on loan to work on specific projects, different tasks would be assigned to each company with MITI supervision to prevent duplication and waste. I don't know whether the amounts mentioned in the Electronic Business article are correct, but at least one reason why discussions for this project have been going on for as long as a year already is that the companies themselves are very reluctant to make what would be large contributions to the project. For, while some

funding would come from MITI, as in the past this funding would be insufficent for the tasks allotted and considerable cost-sharing would be required. An additional problem for the companies appears to be the long-term nature of the investment required; ten years is a mentioned term to payoff. I assume that this year's business downturn, which has affected the Japanese companies as well as their American competitors, will make them even less willing to kick in now than last year.

If MITI keeps listening to the advice it has been getting--which has been good in the past and has resulted in successful programs--then this ten-year project on 0.25 micron production technology will probably get off the ground as soon as consensus among the participants is reached. The details of the program may be different from those reported here, but the overall goals will probably be the same. And, no doubt, MITI will make details of the project available when it is officially announced, as it has done with earlier projects.

A visit to some of the fab areas in Kyushu, and talking with the Japanese engineers building and running them, indicates that a MITI thrust might not be necessary to wipe out American semiconductor production equipment sales in Japan; the American manufacturers seem to be doing a good job of this themselves. In the newest plant I visited (not yet in operation but still not the most modern in Japan) the only American machinery I could see was AMT etchers, Teradyne linear IC testers, and Tektronix (actually Tek/Sony) curve tracers. I was also told there were some American ion implanters. While that company's just-previous line used GCA steppers and WaferTracs, and a lot more American etching equipment, all the litho equipment on the new line was Nikon steppers. When I asked the plant manager exactly why it was that he felt Nikon would soon have 90% of the stepper market in Japan, he mentioned technical reasons, including footprint; but he said that a much more important problem was service. In fact, the only American company he had kind words for in terms of service was AMT (which is not to say he had unkind words for others, but he could only answer my question, "Which American companies have acceptably good service?" with that one company's name). In addition, he added that he felt American companies often refuse to make "small" changes in machines for their customers. It doesn't take much to make a Japanese purchaser think "buy Japanese"; if he can justify a decision to do so using the reasons given him by the American equipment companies as given above.

One can learn a lot about Japanese semiconductor production without even entering a Kyushu fab plant. If you feel the success of such a plant depends on its workers, muse on the structure of the NEC plants in Kumamoto. In the very middle of the plant complex, straddled by water filtration and air-scrubbing facilities and by a backup power station, are six dormitories for the unmarried workers--in fact most the the line workers. These workers need never leave the plant grounds or, for that matter, need never leave a covered walkway to get to work, or back home. The average length of service for the women workers is almost seven years, after which they usually leave of their own accord to get married. They are trained in one specific job

(e.g., setting up an automatic TC bonder) and remain in that job unless they ask for another, or are promoted. They have a high school, perhaps further, education heavy in quantified subjects, can speak the native tongue of their engineer-supervisors fluently, and know enough English to handle the computers on their machines, which often use English-language commands. NEC is not unique in the nature of its fab workers; the living arrangements and turnover rates are typical for workers in any large Japanese company.

Kyushu strikes the observer, incidentally, as something like what the Santa Clara region was twenty years ago--uncrowded, gentle green hills, clear air. Of course, overlaid with high-tension towers and the particularly nasty modular-construction Ramen shops with which Japan seems to grace every natural beauty spot, but in any case different than Kawasaki. During the time there was a streak of fab-building in Kyushu, the place got the name "Silicon Island." However, climate alone does not make a winning streak, and new fab areas are now being built in the snowy North; viz., the island of Hokkaido and Niigata Province on the north coast of Honshu. Niigata absorbs the Siberian cold and snows in an act of sacrifice for which Tokyoites are grateful, but it's not gratitude that persuades companies to build new fab plants there: local tax forgiveness and other benefits, plus plenty of power and water--which are beginning to be scarce in Kyushu--did the trick.

Here is a rundown on some of the latest thinking on GaAs digital ICs here. At least one highly placed person at one of the CPU-makers' research labs feels that the key to applying GaAs ICs in CPUs is the uniformity of threshold voltage over the wafer. NTT also concluded as much from its recent fairly large-scale tests on devices made on In-doped and undoped substrates, discussed in an I.E.C.E.J. Symposium on GaAs devices and circuits in January. At that time, NTT said that defect densities as low as those currently produced in their "defect free" (DF) Czochralski wafers are necessary. Many here agree with the numbers on defect density but wonder whether indium doping is the way to reduce it, expressing concerns about the stability and uniformity of that doping. After a recent restricted (I couldn't get invited) industry-wide symposium on GaAs materials at Shimoda, one independent materials expert told me that the way the indium works to produce DF material is by raising the temperature level at which a given amount of stress will produce dislocations, and hence threshold voltage variations. Clearly, a more basic approach to this problem than indium doping is to reduce the stress itself, by such methods as finely controlled growth using realtime computer servos, in situ localized heating of the melt, etc. The Optical Joint Research Lab has already applied some of these techniques and has greatly reduced the defect density of undoped substrates; at least one large silicon supplier is apparently also working on some good ideas. The materials expert, while admitting that more must be known about the connection between dislocations and threshold voltage variations, did also feel that DF undoped 3" substrates would be available in two years. There will be an international conference on semi-insulating GaAs substrates in Japan this fall, and I would expect many of the items discussed at the Shimoda meeting to be presented there, too.

When undoped DF substrates are available in sufficient quantity, the time would be proper for the device and process designers here, who have been developing self-aligned gate and various other production-oriented technologies for GaAs for years, to push hard to get their chips into at least demonstration CPUs. There doesn't seem to be much movement in the direction of optimizing circuit design for GaAs here yet, but the chip fab processes, at least, seem ready to be put in place.

Partly, perhaps, because of national pride; partly because of a feeling that the country may not much longer be allowed to absorb the basic research efforts of other countries at bargain prices in order to create new industries, there is a movement to promote basic R & D capabilities in Japan. The Science and Technology agency recently published a White Paper entitled, "Towards Creation of a New Technology for the 21st Century," and MITI has started a new drive for the fiscal year beginning April 1 to encourage private companies to expand their research programs.

The White Paper is concerned with fundamental research, i.e., "that which aims to discover new knowledge about natural phenomena...without regard to their practical applications." Areas in which it is felt that new fundamental research would be helpful include new materials (glass, alloys, ceramics), where surface and boundary phenomena and the influence of machining and forming on molecular structure should, it is felt, be better understood to facilitate further developments. Another area of interest is life sciences. The final area called out for special mention is that of information and electronics, in which movement toward ULSI will outstrip what is known about device physics even as the devices become so numerous that our knowledge about how to connect them together is exceeded. Therefore, new efforts in brain research, pattern recognition, and computer architecture are deemed necessary.

Statistics presented in the White Paper show that while Japan now spends more on basic research than do France, Germany, or the United Kingdom, the rate of growth of expenditure for this research is less than that for total expenditure for R & D. The expenditure for basic research in Japanese universities is about forty per cent that in U. S. universities, while Japan's total expenditures for basic research are only about thirty per cent of those in the United States. It is pointed out that because of financial stringency and recent promotion of advanced technology, universities and government research institutions in Europe are giving priority to applied R & D, with adverse effects on basic research. As for the United States, however, it was felt that governmental policies were serving to enhance the growth of basic research. Some U. S. policies specifically mentioned included the NSF Presidential Research awards, establishment of such facilities as the new supercomputer centers, and the NSF university-industry joint research programs.

The conclusions of the White Paper make interesting reading:

> "It has become important for Japan to strengthen its capability in continuously creating new technologies by its own efforts....

> "Judging from the number of dissertations, Japan is not making a full contribution as a member of the international community....
>
> "...it is important to increase investment in universities and government research institutions...to give training to creative people who have the desire to pursue unknown themes, promote interchange and cooperation among industry, universities, and Government, and to strengthen the foundation of research through the installation of high-precision high-performance measuring equipment."

Along with these rather general conclusions, the White Paper noted that investment in basic research was being increased considerably by private corporations. Nevertheless, the MITI program aims to help the trend along by making industrial use of the results of the government laboratories easier and cheaper, by providing the low-interest loans for R & D, and by tax incentives for research in certain areas. a new organization called the Basic Technology Research Promotion Center will make loans at 7.1% interest to companies for developing R & D projects; if the efforts fail, the loans would be interest-free. The Center will also serve as a liaison office to help R & D cooperation among industries, universities, and government. Tax reductions will be given for up to seven per cent of the purchase value of capital items for use in R & D in particular areas: electronics, bioengineering, advanced robotics, and manufacturing and processing have been mentioned.

All of these efforts should also be seen in the light of recent governmental efforts to modify the elementary and middle-school education systems, which is extremely rigid in its submission to central control and emphasis on memorization of material to pass university entrance examinations. A reason sometimes given for the necessity to change this system is that a freer one should lead to greater creativity among its graduates. On the other hand, both the White Paper and the MITI program imply a belief that research results can be assured if money is provided. Money will be provided before the school system is changed, thereby providing an interesting test of the hypothesis.

SEMICONDUCTOR RESEARCH CORPORATION

COOPERATIVE RESEARCH

FREY REPORT FROM JAPAN
JUNE, 1985

This is the sixth in a series of Newsletters by Professor Jeffrey Frey, an SRC Investigator at Cornell University who is spending a sabbatical at the University of Tokyo. Arrangements were made for Jeff to provide reports to the SRC about his visit in Japan. These Newsletters are being distributed to members of the Board of Directors and TAB.

This month's interesting news is about the R&D fallout from NTT's "privatization," X-ray lithography, new generation memories, and the Japanese publication structure.

1. Privatization of NTT and R&D Support

Following the American and British examples, NTT has been "privatized," i.e., changed from a wholly government-owned to a private stock company. Of course, none of the shares can be sold to foreigners, and the majority of the shares are held by the government of Japan; but a "private" company nevertheless. It's not as clear what the payoff for the consumer in Japan will eventually be—at least he can buy an alternative telephone now instead of paying NTT about $100 for an old-fashioned black dial unit—but part of the payoff for NTT is the freedom to set up profit-making deals with other companies. For example, NTT and IBM recently announced a joint venture in local area networks (and some Japanese are wondering whether this is only the tip of the iceberg); and NTT is now free to license its technology to any companies that approach it, in contrast to its previous practice of giving it away to its favored suppliers such as Oki or NEC.

An interesting aspect of the implications of privatization for Japanese government spending on research and development has been pointed out to me, however: in the past, NTT profits could be used solely by NTT to support its own research efforts; now, some of the profits will be distributed to shareholders. The major shareholder is the Japanese government, and one might ask what use will be made of its share of the profits. Given

previous history, it is not likely they will be used for aid to Ethiopia, a save-the-whales campaign, or military spending. No, apparently a large part of these profits will go to MITI for support of industrial R&D. As noted here before, MITI's budget is not now really very large, and it helps R&D mostly by suggesting topics, organizing projects, and getting everyone in line. The distribution of NTT profits might change the situation somewhat, and Japanese government support for industrial R&D bears watching over the next few years. It's worth noting (the Japanese do it all the time) that MITI support for R&D is now but a small fraction of American DoD "R&D" expenditures. As the price of this research goes up, the situation might change marginally if there is a source of funds to back it up.

Incidentally, one might wonder why the Ministry of Education (monbushoo) doesn't seem to be on the list for some of the spoils to support university R&D. Apparently, that's because MITI, which commands much more support in the government, doesn't want to share very much with that Ministry, a traditional enemy.

2. X-Rays and Synchrotrons

Speaking of the cost of R&D, one of the largest-budget items being planned for by companies here is a synchrotron, along with the accessory technology to make X-Ray lithography possible. This all started in Japan with NTT, which last fall announced its plans to build a synchrotron at its Atsugi lab. After some exploratory tries to get an American company to build one under contract (something American companies haven't done since the days of the Manhattan Project, and is it time to think again about that?), NTT contracted with Hitachi and Toshiba jointly for construction. Japanese competitiveness being what it is, their own synchrotrons are now apparently on the drawing boards at both companies, which means that NEC and Fujitsu will soon have them too. The thinking here is that the synchrotrons themselves are relatively easy to do, if expensive; it's the masks and alignment schemes that are problems. The high-resolution masks must be made using e-beam machines; Hitachi has been working on high-precision e-beam maskmakers for some time, and Toshiba will soon initiate a project. Incidentally, the only part of the VHSIC program that seems to have people really worried here is the Perkin-Elmer e-beam machine.....Incidentally, also, there is some real surprise that no one in the USA seems to be building synchrotrons for lithography, and some real belief that IBM must be doing it in secret.

3. Good News on the Memory Front

If you haven't finished your soft-error tests on your 1Mb dRAMS yet, you're in for a pleasant surprise, at least if your design is something like those being made here. That is, soft-error rates are much less than expected. Less, even, than those for the 256K dRAMS. Toshiba (soon, Hitachi) is now

testing and sampling 1M chips, and results on their tests as well as those by other prototypers show much lower soft-error rates than expected. The designs and technology are apparently scaled versions of those used for the 256Ks (1.3 micron, no trenches), and the only apparent differences on the cell scale are a higher storage charge density and higher local electric fields. No one yet knows why these pleasant results have been obtained, but the nature of the local talk is that the 1M is going to be a lot easier than anyone thought before. Questions still remain about the 4M, which will probably use some form of trenches; tests on prototype cross sections are now being conducted.

4. Bad (?) News on the Memory Front

This is good or bad depending on what you are. Apparently even with 256K dRAM prices to users at under $4, people are making money on them. This means that yields are somewhere over seventy per cent on this 1.8-2.0 micron technology.

5. Japanese Publishing

I have written before about interesting items of information heard at the semi-annual Applied Physics Conference, the annual meeting of the Institute of Electrical and Communication Engineers of Japan, or at one of the monthly symposia held on selected (and varied) topics by the Applied Physics Society or the IECE. It is especially worth pointing out (particularly for those of you thinking of studying Japanese, or perhaps thinking of supporting university programs in Japanese for technical students) that these conferences are held in Japanese and their proceedings are printed in Japanese. Although these meetings are publicly announced, open to all, and, as mentioned, very interesting indeed, few foreigners attend. If more foreigners did attend, they might bring home the message that company technical information in Japan, at least in its early stages, is much easier to find than in the USA. Those who attended the recent VLSI Symposium in Kobe (in English) might even have concluded the same thing by comparing the interest and quality of the American papers presented there with those of the Japanese papers.

The infrastructure of Japanese information exchange is different than that abroad; lessons might be learned from it. Naturally the Japanese publish in the international journals and at the big conferences, but this work is the best and best-developed, and therefore oldest, of what is going on. Domestically, however, there is a constant stream of publication not only in the meetings noted above, but also in in-house (but generally available) company technical journals and in some Japanese-langugage magazines such as Nikkei Electronics or the new USLI. The Applied Physics and IECE large meetings attract several thousand participants and about as many papers. At last spring's Applied Physics meeting there were, out of some two

thousand papers in all, several hundred on silicon devices, technology, and materials, and perhaps two hundred more on GaAs and GaAs-type devices and materials. At the most interesting of the monthly meetings—such as last January's two-day session in Tokyo on GaAs linear and digital ICs and devices—more than a couple of hundred engineers (and a very small sprinkling of students) might attend from industries all over Japan. So, organs of technical information in Japan should be thought of as the same as those in the US—less, perhaps, some little-publicized and irregular IEEE professional group meetings, SRC special limited-attendance topical meetings, and company-only meetings, plus several very large annual and semi-annual well-publicized meetings with published proceedings, and many monthly meetings, also well-publicized and open, on selected topics. [There are, of course, also closed meetings (e.g., on some MITI future-devices projects or once in a while on such things as GaAs substrates or optoelectronics, or company meetings) in Japan]. One does need, of course, to know some Japanese to get the drift of what's going on, and kanji and kana to dope out the proceedings. Should the SRC perhaps support some machine-translation efforts as well as language training?

We, of course, obtain information through Government, from technical liaison officers, from the National Technical Information Service, and the Departments of State and Commerce. There are also Department of Defense activities. ONR has an office in Tokyo, for example.

In the invitational letter, I was asked to talk about corporate activities that might be germane and I would like to take a couple of minutes to cite three.

On April 23 of this year, Westinghouse and Toshiba announced a joint venture to manufacture high-resolution color tubes. The work is to be done in the Elmira, NY, area and will be manufacturing tubes developed by Toshiba. In addition to providing 800 jobs in the area, which is excellent, we will get information on that technology with no language barrier.

Second activity: For many years, Westinghouse and Mitsubishi Electric have had a program involving the exchange of engineers. They send engineers to the United States; we send engineers to Japan. There is an extensive formal language and cultural training program which our engineers get before they spend a year working in Japanese factories and this is extremely helpful. Again, Senator Rockefeller alluded to that.

I believe the culture is more important than the language. Of course, it is hard to separate them because your language has a lot to do with how you think, but really knowing how to speak. Once, on a trip to Japan, we were running behind and I didn't get all my questions in and one of my engineers had given me a list of questions. I asked if they would write answers. It had to do with integrated circuit modeling, and I provided the questions on how good is the model; how many iterations?

One of the questions was "computer used?" He wanted to know which computer they used. On my sheet it said, "Computer used?" The answer I got back from the Japanese was "Of course." So the way you talk is, of course, extremely important.

One word on technical translation. Earlier this year, Westinghouse started the Westinghouse-Japan Technology Center in Tokyo. It is an extension of a technical presence we have had for years and we feel it will help us. We have Japanese nationals well versed in English and technology and they are a tremendous resource.

With this background, I would like to make a few recommendations, if I may.

I think we should continue to endorse multifirm research and development cooperatives such as the Semiconductor Research Corp., and the Microelectronics & Computer Technology Corp. This is one way we can focus on common problems, leaving more funds available for our innovation.

Continue to endorse seminars on the subject, such as the symposium held at the National Bureau of Standards the past 2 days with their outstanding keynote speaker.

There are several government agencies, government-chartered groups, corporate technical offices and trade groups currently active in Japan. I have insufficient knowledge of all their diverse activities to be exact on this recommendation, but it would appear that some coordination of their activities would be in order. I

would recommend either a center for technical information or one of the existing activities, ONR, National Science Foundation should be designated to lead and coordinate activities in this area.

I endorse the report of the President's Commission on Industrial Competitiveness and recognize that the United States does have big problems. We need innovative and enlightened Government activities. One particular item I would like to pull out of that report is a strong recommendation for the creation of a Federal Department of Science and Technology. We should support VHSIC-like initiatives in other high-technology fields such as GaAs, so while we are worrying about implementation, we don't lose innovation.

Thank you very much.

[The prepared statement and biographical sketch of Dr. Strull follow:]

The Role of Technical Information and Related Matters In Connection with United States Competitiveness with Japan

Dr. Gene Strull, General Manager
Advanced Technology Division
Westinghouse Defense & Electronics Center
Baltimore, Maryland
June 26, 1985

The competitive challenges that the United States faces in our relationship with Japan are formidable. These challenges were well described in the Report of the President's Commission on Industrial Competitiveness: Volume 1, Global Competition; The New Reality. Since the subject is so complex, I will comment mainly on the role of technical information.

My remarks on United States Competitiveness with Japan in high technology fields will concern silicon integrated circuits, GaAs technology, visible and infrared sensors, acoustics, acousto-optics and computers. These are areas in which I work and I have observed on visits to Japan.

I believe the United States is ahead of Japan in most portions of these technologies. However, while the Japanese through MITI share and cooperate in research and development and save their competition for manufacturing, the United States thrives on competition from end to end. So that while there are companies in the Unted States that are ahead of the Japanese,the United States does not have the structure (nor am I advocating that they should) that the Japanese have for focusing on a particular market.

To put my comments in the proper framework I would like to give you my characterization of the United States versus Japan in high technology.

The United States is innovative and entrepreneural, while Japan tends to operate in a more structured manner with decision making by concensus. In the strategy for high technology markets the Japanese have cooperation between management, labor and government whereas we generally tend to be passive at best. Another basic difference between the two countries relates to obtaining capital. In Japan older firms have very "deep pockets" with a much lower return on sales, investments, etc. while in the United States it is the new firms that attract venture capital. A consequence of this difference has resulted in all of the integrated circuit manufacturers in Japan being divisions of large, diverse corporations. These companies are well able to handle the reverses in integrated circuits which have occurred during the current down-turn. Here on the other hand, the majority of our merchant integrated circuit manufacturers do not have this "cushion". The subject is well highlighted in the business section of the New York Times June 16, 1985. As if this was not enough, questionable Japanese pricing policies have recently come to light. However, this is not the current topic under discussion.

I have visited Japan several times since 1980 - most recently in March of 1985. I have met with most major electronics firms and have visited several areas of the country. Of the more than one hundred executives and technical personnel I have met, I can recall only one instance when a translator was needed. The Japanese, in the fields I have mentioned, publish extensively in

English both in publications originating in Japan, such as Japan Semiconductor Technology News (superseded by JST Reports) and in US publications, such as those of the Institute of Electronic Engineers(IEEE). For example, in the February 1985 IEEE Transactions on Electron Devices a (special issue on Very Large Scale Integration) over 40% of the papers are Japanese.

The term "high technology" is used frequently. The "high" more than anything else refers to high rate of change. We are currently in an era where the time between major changes in a technology is often shorter than the time to apply devices emanating from that technology into systems. Lead time thus becomes of paramount importance. Further, integrated circuits are sufficiently complex that devices from different manufacturers that are supposed to be the same do not function exactly the same in all their parameters, particularly at the high performance end of the spectrum. Thus, getting to the marketplace first, even if only by a few months locks in business for years. So, while we obtain in English most Japanese high technology information, there is probably a lag of six months to a year. This can be crucial in the high technology marketplace.

Returning to the competitive strengths of the US versus Japan in integrated circuits and related technologies, the US continues to be the leader in innovation, while the Japanese are ahead and increasing their lead in implementation. I would like to deviate from technical information for a few moments. We must not take our leadership in innovation for granted. It is an edge we must maintain. The Department of Defense Very High Speed Integrated Circuits program (VHSIC) so important to our defense posture, has also had fall-out which should help the integrated circuit industry. This fall-out has occurred in process technology, design, test and equipment. Similar initiatives in GaAs, advanced optics and artificial intelligence, just to name a few, would seem worthy of consideration to keep us leaders in innovation.

The Japanese technical community is concerned about their lack of innovation. As evidence, I cite Report Memorandum #70 from the Tokyo office of the US National Science Foundation dated April 5, 1985 entitled University/Industry Cooperation in Japan: Recommendations of the Japan Techno-Economics Society. The essence of the information can be seen in an editorial from the Mainichi Daily News, March 4, 1985 which I have appended. I would like to quote from this editorial. "The Japanese enterprises, in the course of a shift from the development of science and technologies introduced from overseas, to the development of independent technologies are in dire need of substantial basic studies". From my prospective the problem of competitiveness is hardly related to any language barrier, - as far as innovation is concerned.

However, the situation for implementation is different. In the fabrication of integrated circuits there are of the order of 250 process steps with numerous sublities. Here is where the lead time I just mentioned is particularly important. There are technical meetings in Japan in Japanese a significant time before the technical information reaches the United States. Even more important, the papers that reach International publications tend to be "big picture" as compared to the specifics of device design and fabrication. Here is where a knowledge of Japanese and on-site observation plays an important role. It is the reason we visit Japan and the Japanese visit the United States.

There are already vehicles for obtaining information. Most United States firms involved in competition with the Japanese have offices in Japan which serve as vehicles for obtaining technical data. How early the information is obtained is a complex matter very strongly related to the establishment of long term relationships. The Semiconductor Research Corporation has been taking advantage of the presence in Tokyo of Professor Jeffrey Frey of Cornell University who is spending a sabbatical at the University of Tokyo. The so-called "Frey Report from Japan" concerns the integrated circuit area. The report is timely and I feel it is exactly the sort of information flow the Committee is addressing.

We also obtain information through government . This has come from technical liaison offices of the United States and other embassies and made available through the National Technical Information Service. In addition to the activities of the Departments of State and Commerce knowledge of Japanese technology has also been provided by the Department of Defense. Still, much of the job of obtaining technical data has fallen to those in business and research who need the information. As I mentioned earlier, time is essential to take marketplace advantage of new technology.

I will cite three activities of Westinghouse in connection with Japan . Westinghouse and Toshiba announced on April 23, 1985 a joint venture to manufacture high-resolution color display tubes used with computers and office automation equipment. The work is to be done in a renovated plant in the Elmira, N.Y. area. The new firm will also manufacture television picture tubes that have flatter, more nearly square faces than traditional cathode-ray tubes. Toshiba was a pioneer in this area and introduced product in Japan two years ago under the name "FULL SQUARE." More than just a manufacturing plant with its 800 jobs in the area, the joint venture will also serve as a vehicle for us to obtain technial information with no language barrier.

For many years, Westinghouse and Mitsubishi Electric have had a program involving the exchange of engineers. The Westinghouse Electric/Mitsubishi Electric Exchange Engineer Program (WELCO/MELCO EEP) is a program to provide graduate engineers from each company with a period (12 months) of practical training at the various factories and offices of the other company. The WELCO/MELCO EEP, which includes an extensive formal language and cultural training course evolved from the Westinghouse International Graduate Student Training Program and is registered with the United States State Department, under the U.S. Information and Educational Exchange Act of 1948. Our reference to the program being Exchange Visitor Program No. P-04-965. The WELCO/MELCO EEP, in its present form, allows us to take advantage of the reciprocity which is made available under EVP #P-04-965. We have had twelve Westinghouse participants in the program, each of whom has spent a year working in a Mitsubishi Electric factory. We have learned a great deal about how things really operate in Japan as a consequence of our participation in this program and our engineers have returned with a different perspective of their jobs and with many worthwhile ideas.

Earlier this year Westinghouse started the Westinghouse Japan Technology Center in Tokyo. This is an expansion and continuation of a technical presence the Corporation has maintained in its Tokyo office for several years. The Corporation, with the assistance of Japanese Nationals fluent in English report, translate and respond to request for specific technical information.

These activities have helped to provide a window into Japanese technology and manufacturing. I have several recommendations on how to continue to improve our technology relationship with Japan and to improve our competitiveness.

RECOMMENDATIONS

- Continue to endorse multi-firm Research and Development Cooperatives such as the Semiconductor Research Corporation (SRC) and the Microelectronics and Computer Technology Corporation (MCC). These are activities that can focus on common problems leaving more funds available for innovation.

- Continue to endorse Seminars on the subject, such as the Symposium held at the National Bureau of Standards on June 24-25, 1985 entitled "U.S. Access to Japanese Technical Literature: Electronics and Electrical Engineering".

- There are several government agencies, government chartered groups, corporate technical offices and trade groups currently active in Japan. I have insufficient knowledge of all their diverse activities to be exact on this recommendation, but it would appear that some coordination of these activities could increase the timeliness and effectiveness of the flow of technical information. Either a "center" for technical information should be established, or one of the existing government activities should be designated to lead and coordinate action in this area.

- I endorse the Report of the President's Commission on Industrial Competitiveness and their recommendations because United States industry does have big problems and we need innovative and enlightened government-industry activities. I would like to cite in particular the creation of a Federal Department of Science and Technology.

- Support VHSIC-like initiatives in other high technology fields such as GaAs.

I appreciate the opportunity to appear before you today to discuss this important topic.

(1581C/6/25/85)-R

Gene Strull

Gene Strull is General Manager of the Advanced Technology Division of Westinghouse Defense and Electronics Center, Baltimore. He received his BS in Electrical Engineering in 1951 from Purdue University and his MS in 1952 and PhD in 1954, also in Electrical Engineering from Northwestern University. He was a National Science Foundation Fellow, 1952-1954. He attended the Harvard University Graduate School of Business Administration in 1967 (Program for Management Development).

He has been with Westinghouse since 1954, starting in Pittsburgh. In his present position he is responsible for the development and manufacture of advanced components and sub-systems, such as very high speed integrated circuits (VHSIC), infrared sensors, microwave devices and related items. He has 21 U.S. Patents, over 50 publications and has given several hundred talks and seminars.

Dr. Strull is a fellow of the Institute of Electrical and Electronics Engineers. He is a member of the NASA Space Systems and Technology Advisory Committee. He has been a member of the Army Science Board, an associate member of the Defense Science Board, and a consultant to the National Academy of Sciences.

The Tokyo Office of the
U. S. National Science Foundation

米国国立科学財団東京事務局

Report Memorandum #70 April 5, 1985

University/Industry Cooperation in Japan:
Recommendations of the Japan Techno-Economics Society

The Japan Techno-Economics Society (JATES) recently made its recommendations on the subject of university/industry cooperation. JATES Directors are drawn from very high ranks in industry and in government agencies and public corporations with scientific and technical missions. Activities focus on R&D Management, Technological Forecasting, seminars and symposia on subjects of interest to members and various technology policy-oriented reports. There has been a good deal of recent activity in Japan aimed at improving university/industry cooperation. Such an improvement is seen as required by the effort to develop more new knowledge in Japan*, to acquaint universities with the needs of industry, and to give industry an appreciation of university capabilities. The JATES report will likely have some influence on the evolution of national consensus and policy on university/industry cooperation. The report is transmitted herewith, along with an editorial from The Mainichi Daily News commenting on the report. The JATES report was translated by M. Miyahara of NSF/Tokyo.

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* See NSF Tokyo Report Memorandum #52

RECOMMENDATIONS ON INDUSTRY-UNIVERSITY COOPERATION FOR THE DEVELOPMENT OF ORIGINAL INNOVATIVE TECHNOLOGIES

Koji KOBAYASHI, President
Japan Techno-Economics Society

February, 1985

Promotion of original innovative R&D would require a large number of researchers in government, public research institutes, universities and in private industries, to bring together their wisdom in order to promote a broad-based cross-disciplinary collaboration in research, through "organic" interactions with one another, in basic research, applied research as well as in developmental research for practical purposes.

In Japan, closer industry-university cooperation has been repeatedly and constantly called for over the past 20 years or so, and a large number of suggestions and proposals have been put forward by people from various parts of society. However, industry, the primary performer of the nation's R&D activities, has not yet paid as much attention to this problem as it should have.

In view of the foregoing, Japan Techno-Economics Society (JTEC) had its Executive Committee for Management of Technology (a committee organized by top industrial executives for engineering) start looking into the question of industry-university cooperation by establishing, in August 1982, a Liaison Committee on Industry-University Cooperation.

Since then, the Liaison Committee has dispatched study teams to the United States, conducted literature surveys and held interviews with men of profound knowledge and experience, and attempted to determine both the negative factors hindering industry-university cooperation in the development of original innovative technologies, and positive factors with potential of providing an incentive to greater industry-university collaboration.

Already in the course of this study, the Committee has noticed that various positive measures were being taken at different levels and in different ways, although slowly in pace, for the ultimate purpose of strengthening industry-university cooperation. Yet, there still remain many problems yet to be resolved.

In view of the foregoing, the following recommendations are hereby presented in order to help improve those conditions in Japan considered especially important for the promotion of industry-university cooperation.

Also, in this connection, a plan for establishing an "International Foundation for Basic Research" is presently under review in our Society, and it will be made public as soon as firmly defined.

* * * * * * * * * *

Recommendations

On

Ways Towards Closer Industry-University Collaboration

--For Creation of Original Innovative Technologies--

February 1985

Japan Techno-Economics Society

* * * * *

RECOMMENDATIONS

Proposed below are three recommendations to help improve relevant conditions and environement for the strengthening of industry-university collaboration in this country:

1. STEPS BE TAKEN TO IMPROVE THE "ENVIROMENT AND CONDITIONS" TO INCREASE EXCHANGES OF RESEARCHERS BETWEEN THE INDUSTRY AND UNIVERSITIES.

Industry-university gaps in terms of salaries and other benefits for researchers should be rectified:

Noted in particular in case of researchers moving from industry to academia is the fact that their job experiences while in industry are not counted as highly as those of a scientisist employed in a university continuously from the start of his career; a "dis-incentive" factor for personnel exchanges, due to lower salary scales and reduced annuities for the industrial scientists being exchanged. Thus, steps need to be taken to correct such discrepancies.

Steps should be taken to establish systems for exchanging research personnel on a regular basis between the industry and universities.

Needed in particular are steps to help establish and expand programs for "visiting professorship", "part-time lecturership", "research trainineeship" and for "sabbatical (research) leaves", thereby assuring that a certain pre-determined number of researchers would be always available for exchanges.

For scientists in engineering schools or other departments in universities, an experience of working, at a young age, on R&D projects in industrial companies would be extremely useful and effective in the development of their future research capabilities. Threfore, steps should be taken to increase exchanges of younger scientists in particular.

Steps should be taken for exchange of scientists from universities to help deepen their "understanding and knowledge of patents" and strengthen patent management capabilities.

In order to have results from joint research projects transformed into effective and strong patents as much as possible, steps should be taken for the university scientists concerned to increase their knowledge of patents.

2. STEPS BE TAKEN TO GIVE "INCENTIVES" TO THE USE OF RESEARCH FUNDS FOR INDUSTRY-UNIVERSITY COLLABORATION.

To allow flexibility in the use of research funds at universities.

With respect to reseach funds provided by private industries either for "contract research", "joint research" or as "donations", arrangements should be made to allow "flexibility in use of the funds", permitting for example mingling with such other funds as for personnel costs, or other research funds, or permitting transfer of funds between different financial categories, so as to ensure a maximum return of the invested funds for research.

Steps be taken for a reform of existing research support systems for researchers at national universities.

In order to enhance research "vitality" of national universities, the current practice of allocating funds for a mixed category of both "research and educational activities" of faculty members (based on the so-called "Koza system") should be modified into a system to allocate research funds specifically for each individual research project; just like the research grant system of National Science Foundation (NSF) in the U.S. At the same time, there should be established in each university a system for open solicitation of proposals for joint research with private industries, along with a review mechanism therefor.

Also, arrangements should be made to have funds for "research per se" combined with funds for hiring "research personnel", so that a principal investigator may choose and recruit his co-investigators or research assistants directly according to the needs of the specific research project. (This is called a "soft-job" system in the United States).

Steps should be taken to provide preferential treatment in taxation for the investments made by private industries in basic research.

Funds invested by private companies for R&D in universities, in particular, should be considered for tax exemption or substantial deduction.

3. STEPS BE TAKEN TO IMPROVE THE SYSTEM FOR CONTRACT RESEARCH INVOLVING INDUSTRY-UNIVRSITY COLLABORATION.

Steps be taken to diversify modes for contract research in order to best meet the content or purpose of each research project proposed.

For example in the United States, if a Federal agency (like NSF) intends to conclude a contract with an external research organization for a project with clearly pre-defined end-results, the contracting party will be expected to fulfill the mission precisely as specified in the contract. On the other hand, however, for those projects without any pre-specified end results, there are available a wide variety of modes for contract research, often permitting greater flexibility in executing the research concerned. In any event, "proper profits" are always acknowledged and included in research contracts.

Thus, steps should be taken to incorporate these advanced concepts of contract research in order to improve our own systems for contract research.

As regards ownership of research results and publication thereof, arrangements should be made in such a way to give incentives to both the industrial and university partners.

With respect to any patent rights resulting from industry-university cooperation, in particular, applications for patents should be submitted in joint names of both parties. And, while actual preparation and submission of patent documents would be handled, with the associated costs also borne, by the industrial partner, in view of their extensive experience in patent applications, the industrial partner should be offered a priority in licensing the patent rights concerned.

Steps should be taken to simplify various procedures for research contracts.

Especially important would be to reduce the requirement or simplify procedures for "interim reports" to be prepared under the terms of reseach contracts, so that the researchers can fully devote themselves to research activities per se.

Translation: MMiyahara:ys

EDITORIAL

MAINICHI DAILY NEWS
Monday, March 4, 1985

University And Industry

The Society of Economy and Science and Technology has announced a report emphasizing the urgent need for establishing a university-industrial complex on a more solid basis to meet the fast changing international environment.

How to link the university with the industrial world is an old but new problem. Since 1960, more than 40 proposals and research reports have been published, including the first recommendation published by the Science and Technology Agency. Nevertheless, the much-publicized cooperation and teamwork between the industrial world and universities have made but little progress. The current proposal of the society pointed out the actual state of affairs concerning the poor showing in the cooperation of the university-industrial complex.

The proposal noted that the industrial world now needs teamwork with academic circles in the true sense of the term. The "tie-up between the industry and the academic world" has so far ended in much ado about nothing. For this, the industry should be held responsible as it has paid little attention to the otherwise outstanding performance of the academic circles. The industry has attached importance to universities merely as a source for providing it with needed personnel. Industrial circles have been enthusiastic about having special relations with specific colleges and universities as well as research centers as suppliers of human resources.

The Japanese enterprises, in the course of a shift from the development of science and technologies introduced from overseas, to the development of independent technologies are in dire need of substantial basic studies. Interdisciplinary studies with the cooperation of various fields concerned have become all the more important in parallel with the sophistication and diversification of technologies. Such fundamental and interdisciplinary researches can no longer be held in the hands of a single enterprise. Hence, industries have come to place high expectations on cooperation with universities.

Japan today has a total of 350,000 persons engaged in scientific and technological research, including 210,000 in the private sector, 110,000 in universities and 30,000 in state-run research organizations. Those in the private sector and universities occupy 90 percent of the total, indicating the essential nature of the proposed teamwork among the industry, universities and government organizations.

The latest proposal has put emphasis on creating suitable environmental conditions to promote industrial-academic cooperation. It called for enlargement of the training system and personnel exchanges, including guest professors and part-time lecturers. The management of the contributions of funds from enterprises should be made more flexible, and the research contract between universities and enterprises should be improved, the proposal stated.

Such proposals made by enterprises will be further strengthened since they are in conformity with the government position, as represented by the concepts of the Science and Technology Agency and the Ministry of International Trade and Industry.

It is not desirable for industrial-academic tie-ups to be promoted onesidedly by the enterprises. Colleges and universities have their own independent missions and the roles they have to play. Missions inherent with universities should in no way be undermined by the proposed cooperation.

In Japan, research and study in the field of science and technology have been centered on state-run universities. Those researches managed by taxes should not be utilized for the industrial-academic tie-up that may benefit specific enterprises. It is inadvisable to give priority to big enterprises and leave small business behind in this field. As the past record shows, private tie-up between individual professors and certain enterprises has more often than not led to misappropriation of research funds.

Furthermore, we should be careful not to place specific emphasis on and expand only certain fields in response to the needs of the enterprises. The question is how to adjust the business secrets and the freedom of publishing the results of researches.

Industrial-academic cooperation and tie-ups are found to make progress, although on a gradual basis. The universities are urged to take the initiative.

Mr. WALGREN [presiding]. Thank you very much, Dr. Strull, it was very helpful and interesting testimony.

Let's continue, then, with Professor Daub.

Dr. DAUB. Mr. Chairman, I will restrict my testimony to the problems of teaching technical Japanese.

Our approach at the University of Wisconsin is to require students to take beginning Japanese for 1 year before studying technical Japanese. One year of Japanese at our university consists of 12 credits. We do not believe that technical Japanese should be taught at a university as a decoding skill.

Therefore, we require that the student first grasp the essentials of conversation, grammar, reading, and writing. Our first-year course does so and does it very well.

We find that able science and engineering majors can master technical Japanese with that amount of background when taught with our textbook, "Comprehending Technical Japanese," in small classes for two semesters and a total of six credits.

Not only do they complete the book, but they also spend 6 weeks of the second semester developing special competence in their own technical disciplines. This last phase of the course is worth some comment.

Our book is based on the most frequent Japanese characters in each of the three main fields of physics, chemistry, and biology. Japanese characters, KANJI, represent the major barrier to becoming fluent in reading technical Japanese. They are cumbersome to look up in dictionaries.

The key to fluency is to master those characters that appear most frequently. That is why our book is based on the most frequent characters in the three major divisions of science and also why we give our students time to tabulate for themselves the special collection of characters in their own fields of study.

When students do so, we are amazed at how many of these characters have already been covered by our textbook. In preparation for the recent conference at the National Bureau of Standards, I reviewed a list of terms for electrical engineering and electronics and found almost complete coverage. It is strange to say, one that we had not covered was the character for nudity used in Japanese electrical engineering terminology to refer to bare wires.

I will return to this subject of character frequency when I suggest the need for special texts to teach technical Japanese to research scientists and engineers in various disciplines.

Our main problem has been in attracting students and we have recently proposed to the university academic affairs committee that a corpus of courses in Japanese, when completed by a science or engineering major, should lead to the designation on the student's transcript, "Certificate in Basic and Technical Japanese." We have canvassed the science and engineering departments for support of this certificate for their majors and we can now publicize the certificate to entering freshmen so that they can plan their curriculum to include it.

The corpus consists of the following: First year, introduction to Japanese culture and civilization for 3 credits; second year, beginning Japanese for 12 credits; third year, technical Japanese for 6 credits.

The strategy here is to begin with a general background of Japanese culture, which proves helpful in understanding the language; to postpone the heavy demand on time for beginning Japanese to the second year when the large blocks of hours for chemistry, physics and calculus are past; and to have the student master technical Japanese in time for his senior year when he specializes in his major field.

We will launch this program in the fall semester and expect to solve the problem of attracting students. We have frequently had inquiries from juniors and seniors about taking technical Japanese, only to disappoint them with the word that they will need 12 credits of beginning Japanese, for which they no longer have room in their demanding schedules.

Not only should this program solve the problem of reaching students, it also offers the student what I consider to be the right amount of Japanese studies prior to entering industry. It gives them the general understanding of Japan and its people, a foundation for developing communication skills, and an ability to serve as a consultant for their industrial colleagues on the content of technical literature.

Some university people in Japanese studies would require more language study. However, I find it difficult to recommend that to an undergraduate student because it may never pay off for them. Interviews with companies have convinced me that they choose their staff for international projects on the basis of ability in their discipline and contributions to the company, and not on prior international studies at the university. Thus, we are satisfied with our text and with a program that prepares the student to contribute immediately to his company as a consultant to colleagues in understanding technical literature and to contribute substantially more if assignment to Japan should come his way.

Lest someone say that my testimony is anecdotal, may I point out that a recent survey of American universities has reported that the University of Wisconsin-Madison is the only one teaching technical Japanese. I expect that curriculums and teaching materials will be developed at other universities, and I wish them Godspeed. However, my colleague, Prof. R. Byron Bird, and I now want to turn our attention to developing teaching materials, not for university instruction, but for research scientists and engineers in industry, research institutes and Government agencies.

At the Wilson Center conference, we frequently heard from research scientists that they had purchased "Comprehending Technical Japanese," but did not have adequate background in beginning Japanese to master it. Professor Bird recently visited research laboratories in Holland where our text is used to develop translation skills and heard similar stories. We intend, therefore, to prepare a basic technical Japanese grammar and reader for scientists and engineers who want to read technical Japanese literature without taking the time to learn beginning Japanese.

Such a program of study has already been developed at the University of Sheffield in England by the Center for Japanese Studies. That program began in 1970 and can prepare scientists for translation within their own discipline through intensive study over a

period of 7 weeks. The center also offers the course of study by correspondence.

Should we, then, attempt an alternative program? How would it differ? We believe that our alternative program will be significantly different. The Sheffield approach treats the translation task as one of decoding, giving rules for using specialized grammar dictionaries that they prepare. We intend to approach the task in a way that will promote an understanding of the Japanese language structure, an understanding that will easily transfer to conversational skills if the scientist chooses to develop them.

In addition, we will base the readings in the book on the most frequent KANJI characters to be found in all the sciences, based on common concepts such as law, theory, observation, experiment, and fundamental properties and substances such as electrical, magnetic, organic, and inorganic. The book will conclude with specialized character frequency lists for the major disciplines, electrical engineering, pure chemistry, industrial chemistry, metallurgy, mechanical engineering, life sciences, physics and geosciences, and a compilation of special constructions found in technical Japanese for ready reference.

Since such a book will be for self-study, we will need financial support to gather a group of scientists and engineers to test and revise it before it takes final form. Moreover, we should like to develop a set of technical readers specific to each discipline, whereby a scientist or engineer could develop fluency in his own field after completion of the basic technical Japanese grammar and reader.

I believe the need for education in technical Japanese is not going to pass away. Japan will always be at the forefront of research and development and the results of Japanese R&D will never be packaged for the convenience of Western readers.

We cannot wait for our laggard university community to produce competence in reading technical Japanese. We need a program to put those skills into the minds of our greatest resource, mature scientists and engineers engaged in R&D in our industries and research institutes.

Thank you.

[The prepared statement and biographical sketch of Dr. Daub follow:]

TESTIMONY TO THE SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY

BY

Professor Edward E. Daub, College of Engineering, University of Wisconsin

June 26, 1985

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BIOSKETCH

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Professor Daub has degrees in chemical engineering (B.S. 1945, M.S. 1947, University of Wisconsin), theology (M.Div. 1950, S.T.M. 1960, Union Theological Seminary, New York City), and history of science (Ph.D. 1966, University of Wisconsin).

His knowledge of Japanese derives from intensive study at Yale University and the Naganuma Language School in Japan (1950-1952) and two terms as a fraternal worker (missionary) to the United Church of Christ in Japan for the Presbyterian Church: assisting Japanese pastors in churches in industrial neighborhoods of Osaka (1952-1956) and teaching chemical engineering and doing student ministry at Doshisha University in Kyoto (1957-1962).

He has developed special competence in technical Japanese by lecturing in Japanese at Doshisha University and editing English translations of Japanese technical manuscripts for Doshisha University and Kyoto University Faculty (1957-1962), translating technical articles in diverse fields for American companies, and co-authoring COMPREHENDING TECHNICAL JAPANESE (1975) with R. Byron Bird and N. Inoue.

He has taught technical Japanese at the University of Wisconsin for the past five years using this text book.

Mr. WALGREN. Thank you very much, Professor Daub.

We will go on to Mr. Rogers and then return to the panel as a whole.

Mr. Rogers.

Mr. ROGERS. Mr. Chairman, members of the subcommittee, I appreciate very much the opportunity to appear before you today to present testimony on the subject of what technological improvements have been made to translate scientific and technical literature by computers.

My acquaintance with the subject results from service on an interagency committee established some time ago to investigate feasibility of acquiring a Japanese machine-assisted translation capability for the United States Government. In order to evaluate such a project, it was necessary to assess the status of machine translation in general and the application of this technique to Japanese in particular.

My remarks are based on what I have learned as a result of service on this committee.

At the dawn of the computer age when the concept of artificial intelligence was being formulated, one of the first projects to be undertaken was machine translation. Unfortunately, the farsighted pioneers in the field were overoptimistic concerning the capabilities of primitive computers and naive about the complexities of the linguistic problems involved. As a result, they oversold the product, creating the expectation of the rapid production of a system that would accept raw input and produce a product rivaling that of human translators, all untouched by human hands.

When the initial efforts revealed rather quickly how far from the mark these first rosy projections were, an unfortunate negative reaction set in. Practitioners of artificial intelligence virtually wrote the concept out of their lexicon and the term acquired distinctly negative connotations. For that reason, I propose to use the term "machine-assisted translation" to describe the most advanced systems of today, which are beginning to approach the capabilities originally envisaged for machine translation.

For we now have some systems whose raw output in some technical fields is satisfactory for awareness purposes, and, with a minimal amount of postediting, is an acceptable, albeit often inelegant, substitute for good human translation. Indeed, in some respects, the latter can be superior.

In the early days of machine-assisted translation, numerous research projects were being pursued at universities in the United States and Canada in the late 1950's and early 1960's. These efforts were encouraged and often supported by the U.S. Government. This was particularly true of the Defense Department, seeking ways to satisfy its growing requirements for translations of Russian technical material. Despite significant progress, the early practical results were disappointing compared to the glowing initial promises. Congress then commissioned the National Science Foundation to perform an assessment of machine-assisted translation which resulted in the disastrous ALPAC—Automatic Language Processing Advisory Committee—report in 1966. The principle finding of the committee is summarized in the following quotation from its report, and I quote: "In view of labor, time, costs and the rate of

erroneous translation, machine translation cannot be put to practical use."

While this conclusion was justifiable based on the then-existing state of the art, the report failed to hold out substantial hope that this would change over time based upon advances which should have been projected in computer science and linguistics and their application to machine translation.

Indeed, the report recommended that Government funding be terminated, and it was widely interpreted as concluding that no effective machine translation or machine-assisted translation system could be expected in the foreseeable future.

At least one Government-sponsored project did, however, survive. This was the Systran system for Russian-English translation growing out of an earlier Air Force-funded project in cooperation with Georgetown University. After early development, the system was installed in 1969 at FTD, at Wright-Patterson Air Force Base, the Foreign Technology Division of Air Force, in an attempt to help meet their requirements for rapid, large-volume translations of Russian scientific and technical literature.

Development and utilization of this system, the one which I personally am more familiar, has continued down to the present with increasing levels of effectiveness. At first, its only virtue was speed. It reached the breakeven point in cost around 1976. A 1981 study showed it to be producing translations at one-third to one-half the cost of contracted human translation. As development continues and dictionaries improve, the cost advantage of machine-assisted translations can only be expected to increase. The main justification for the system in the FTD context is, and will continue to be, speed, for it is capable of translating upwards of 300,000 words per hour.

Based upon the success of the Russian system, FTD recently installed a French-English version and also it is installing a German-English adaptation, with expectations that comparable results will be achieved in a fraction of the time.

Despite the negative effect of the ALPAC report, a few other efforts also continued. The slow but steady progress made by the Systran system and other survivors, coupled with the expansion of international trade, the emergence of the multinational corporation and the worldwide information explosion, has recently sparked a renascence of interest in machine-assisted translation.

In this country, at least two families of systems, in addition to the Systran system, are being marketed with some success, including that of Dr. Edwin Young of Brigham Young, the system known as the Automated Language Processing System, or ALPS, which supports translations from English to several Romance languages, German, and Arabic, in which work has been done in Japanese. In addition, Weidner Communications markets systems based on both personal computers and minicomputers for providing translation capabilities between English and a large group of languages, including as well, Japanese.

I am personally familiar with one operation using the Spanish-to-English system and this reports substantial improvements in productivity through the use of the system. One of the Japanese customers and sponsors of its Japanese system, Bravice International,

was so impressed with its potential that they bought the company and Bravice owns 51 percent of Weidner and is marketing their product in Japan now.

Progress continues to be made in Canada and projects are reportedly underway in much of Western Europe, Brazil, and Hong Kong. The European Community Council has undertaken perhaps the most ambitious project of all, EUROTRA, but because of its scope, many in the field are skeptical of the outcome of this, although many expect that much will be learned about the process of machine-assisted translation regardless of whether this project achieves successful results in the foreseeable future.

Let us turn to Japan, where a veritable explosion of activity is now underway. With a single exception, none of the current projects began until 1979. This is understandable, given the complexity of applying the yet relatively primitive techniques of machine-assisted translation to Japanese. First there is the problem of data input, given the fact that there is, as yet, no satisfactory Japanese typewriter nor even an efficient word processing system.

But if the data input problem were not enough, consider the following partial list of problems involved in translating between English and Japanese:

Their lack of word boundary markers in Japanese;

The frequency of implied subjects;

The substantial differences in both syntax and semantics;

The Japanese predeliction for complex stacking of clauses within a single sentence;

The paucity of punctuation and lack of capitalization; and

A recent whole importation of Western terminology with no effective standards for transliteration.

Despite these daunting obstacles, their continuously expanding requirements for more efficient translation capabilities, combined with their observation of progress being made in machine-assisted translation in the West, induced the Japanese some 6 years ago to embark on wholesale attempts to harness the computer to help solve their problem.

The current Japanese projects are divisible into two categories. In the first belongs the natural language processing and machine translation component of MITI's widely touted fifth-generation computer project. Based upon its ambitious goals and progress made to date, little or no practical results should be expected from this project in the near future, in my opinion.

In the second category are systems designed for immediate and practical results. One of the most interesting of these began its development here. Several years ago, a Japanese company, IONA, contracted with Dr. Toma to adapt his Systran Russian system to Japanese. After achieving a relatively advanced state of development, IONA assumed control of the project and transferred further activity to Japan last year. The English-Japanese version is being marketed and is in active production in a Tokyo translation services bureau. The Japanese-English version requires additional development which IONA states it will begin in the near future. I have personally observed this system and consider it to have excellent potential for achieving effective operation.

In addition to the Weidner systems, implemented on minicomputers which limits their production rate, Bravice has announced that it will soon market an expanded version designed to run on mid- and large-scale machines. As far as I was able to learn when I was last in Tokyo in April, marketing had not yet been commenced.

In addition to these systems, most of the larger Japanese computer manufacturers have announced, but have not yet begun to market machine-assisted translation systems. These include Fujitsu, Hitachi, and Nippon Electric.

Of these projects, the Hitachi Atlas II system seems closer to fruition. Based on discussions in Japan, particularly with persons in the U.S. Embassy who had personal contracts with Fujitsu officials, I learned that Fujitsu had recently moved this development from their research and development division to their translation department and are beginning to use it for the production of translations for internal corporate purposes.

Its announced characteristics are impressive for an initial development, but it has one distinct disadvantage, particularly for any proposed application in this country. This is that it reportedly requires a substantial amount of pre-editing of the text in that clause boundary markets must be inserted in the text of complex sentences.

To my prepared remarks, I have attached a chart giving the most significant announced details concerning virtually all of the large-scale system developments in Japan.

Based upon what I have learned, I have reached certain conclusions which I would like to share with this subcommittee. While there is no lodestone yet in sight which can be used to readily transmute the large and growing volume of Japanese scientific and technical literature into a form readily usable by the English-speaking audience, great progress has been made in machine-assisted translation in general and in its application to Japanese in particular. Given the growing importance of access to Japanese scientific and technical literature, it would be unwise for the United States to adopt a posture of waiting and seeing if the Japanese will come up with solutions to our problems.

For these reasons, the committee on which I have been serving has recently recommended the commencement of an interagency project to acquire a Japanese language machine-assisted translation capability for the U.S. Government. If possible, this will be built around one of the systems already in an advanced stage of development.

All involved realize that no quick and easy solution to the problem is yet at hand and that a substantial and initial investment will be required before dividends can be expected. Despite the difficulties in our way, I am convinced that the problem is not insoluble and that, given time and a reasonable investment of resources, machine-assisted translation can make a substantial contribution toward the goal of improving our access to Japanese scientific and technical literature.

Mr. Chairman, that concludes my prepared remarks. I would like to state that machine translation and machine-assisted translation has its theological advocates and theological opponents and many

of them—the opponents always say, "Well, you know, what comes out is garbage." I thought, perhaps, if you hadn't seen any, you and the other members of the committee would like to see a sample of a very interesting document. It was translated—it is a translated excerpt from a Soviet book called "Problems of Machine Translation," published in Moscow in 1983.

It was translated on the machine-assisted translation system and has been very lightly edited. It has had some post-editing, but if one would glance at it, you will see it has not been substantially re-edited, yet if one has a reasonable acquaintance with computerese and some acquaintance with linguistic terminology, then I think the actual meaning of the author comes through loud and clear and it is not hard to read.

I would proffer some copies of this in case anyone would like to review it.

[The prepared statement of Mr. Rogers follows:]

Prepared Statement of Testimony
of
George W. Rogers, Jr.
before
Subcommittee on Science, Research and Technology
Committee on Science and Technology
U.S. House of Representatives
June 26, 1985

Mr. Chairman and members of the subcommittee. I appreciate very much the opportunity to appear before you today to present testimony on the subject of what technological improvements have been made to translate scientific and technical literature by computers. My acquaintance with the subject results from service on an interagency committee established some time ago to investigate the feasibility of acquiring a Japanese machine-assisted translation capability for the US Government. In order to evaluate such a project it was necessary to assess the status of machine translation in general and the application of machine translation techniques to Japanese in particular. My remarks today are based upon what I have learned as a result of serving on this committee.

At the dawn of the computer age when the concept of artificial intelligence was being formulated, one of the first projects to be undertaken was machine translation. Unfortunately the farsighted pioneers in this field were initially overoptimistic concerning the capabilities of their then rather primitive computers and naive about the complexities of the linguistic problems involved. As a result, they oversold the product creating the expectation of the rapid production of a system that would accept raw input and produce a product rivaling that of human translators all untouched by human hands. When these initial efforts revealed rather quickly how far from the mark these first rosy projections were, an unfortunate negative reaction set in, the practitioners of artificial intelligence virtually wrote the concept of machine translation out of their lexicon, and the term acquired distinctly negative connotations. For that reason I propose to use the term "machine-assisted translation" to describe the most advanced systems of today which are beginning to approach the capabilities originally envisaged for machine translation, for we now have some systems whose raw output in some technical fields is satisfactory for awareness purposes, and, with a minimal amount of post-editing, is an acceptable, albeit often inelegant, substitute for good human translations. Indeed in some respects it can be superior.

In the early days of machine-assisted translation numerous research projects were being pursued at universities in the United States and Canada in the late 1950s and early 1960s. These efforts were encouraged and often financially supported by the US Government. This was particularly true of the Defense Department, seeking ways to satisfy its growing requirements for translations of Russian technical material. Despite significant progress, early practical results were disappointing compared to the glowing initial

promises of many of machine translation's original proponents. Congress then commissioned the National Science Foundation to perform an assessment of machine translation which resulted in the disastrous ALPAC (Automatic Language Processing Advisory Committee) Report in 1966. The principal finding of the committee is summarized in the following quotation from its report: "in view of labor, time, cost and the rate of erroneous translation, machine translation cannot be put to practical use." While this conclusion was justified based upon the then existing state-of-the-art, the report failed to hold out substantial hope that this would change over time based upon advances which should have been projected in computer science and linguistics and their application to the machine translation problem. Indeed the report recommended that government funding be terminated, and it was widely interpreted as concluding that no effective machine translation or machine-assisted translation system could be expected in the foreseeable future.

At least one government sponsored project did, however, survive. This was the Systran system for Russian-English translation which grew out of an earlier Air Force funded project in cooperation with Georgetown University. After early development by Rome Air Development Center, the system was installed in 1969 at the Foreign Technology Division, Wright-Patterson AFB (FTD), in an attempt to help meet their requirements for rapid large volume translations of Russian scientific and technical literature. Development and utilization of this system, the one with which I am most familiar, has continued down to the present with increasing levels of effectiveness. At first its only virtue was speed. It reached the break-even point in cost around 1976. A 1981 study showed it to be producing translations at 1/3 to 1/2 the cost of contracted human translations. As development continues and dictionaries improved, the cost advantage of machine-assisted translations can only be expected to increase. But the main justification for the system in the FTD context is, and will continue to be, speed, for it is capable of translating upwards of 300,000 words per hour.

Based upon the success of the Russian system, FTD recently installed a French-English version and is now in the process of installing a German-English adaptation. Responsible officials are confident similar results will be achieved with these systems in a fraction of the time required to develop the Russian system.

Despite the negative effect of the ALPAC Report, a few other efforts also continued. The slow but steady progress made by the Systran system and other survivors, coupled with expansion of international trade, the emergence of the multinational corporation and the worldwide information explosion, has recently sparked a renascence of interest in machine-assisted translation.

In this country at least two families of systems, in addition to the Systran system developed by Dr. Peter Toma, are being marketed with some success. Dr. Edwin Young of Brigham Young University developed the Automated Language Processing System known as ALPS. This system reportedly supports

translations from English to several Romance Languages, German and Arabic. Work has been done in Japanese. In addition, Weidner Communications is marketing systems hosted on both personal computers and minicomputers providing translation capabilities between English and a large group of languages, including French, German, Spanish, Portuguese and Japanese. I am personally familiar with one operation using the Spanish to English system which reports substantial improvements in productivity through use of the system. One of the Japanese customers of the Japanese system, Bravice International, was so impressed with its potential that they recently literally "bought the company." Bravice now reportedly owns 51% of Weidner and is marketing their Japanese system in Japan.

Progress continues to be made in Canada, and projects are reportedly underway in much of Western Europe, Brazil and Hong Kong. The European Community Council has undertaken pernaps the most ambitious project of all, EUROTRA. Faced with the overwhelming problem of translating between nine languages (a total of 72 language pairs), the EUROTRA project is designed to provide translations from any one of the Community's languages into all others simultaneously. Although the project is new and many practitioners in the field are skeptical of the outcome because of its scope, much should be learned about the process of macnine-assisted translation regardless of the practical results achieved.

Let us turn to Japan where a veritable explosion of activity is now underway. With a single exception, none of the current projects there began until 1979. This is understandable given the complexity of applying the as yet relatively primitive techniques of machine-assisted translation to Japanese. First there is the problem of data input given the fact that there is, as yet, no satisfactory Japanese typewriter nor even an efficient word processing system. I was in Tokyo in April and observed secretaries in a law office attempting to enter text into the latest of Japanese word processors. The rates of speed were agonizingly slow, not much better than the archaic mecnanical monsters in use when I was first in Japan in 1946.

But if the data input problem were not enough, consider the following partial list of problems involved in translating between English and Japanese:

- lack of word boundary markers;
- frequency of implied subjects;
- substantial differences in syntax and semantics;
- the Japanese predeliction for complex stacking of clauses within a single sentence;
- paucity of punctuation and lack of capitalization; and
- wholesale importation of Western terminology with no effective standards for transliteration.

Despite these daunting obstacles, their continuously expanding requirements for more efficient translation capabilities combined with their observation of progress being made in machine-assisted translation in the west induced the Japanese some six years ago to embark on wholesale attempts to harness the computer to help solve their problem.

The current Japanese projects are divisible into two categories. In the first belongs the natural language processing and machine translation component of the Ministry of International Trade and Industry or MITI's widely touted fifth generation computer project. Based upon its ambitious goals and progress made to date, little or no practical results should be expected from this project in the near future.

In the second category are systems designed for immediate and practical results. One of the most interesting of these began its development here. Several years ago a Japanese company, IONA, contracted with Dr. Toma to adapt his Systran Russian system to Japanese. After achieving a relatively advanced state of development, IONA assumed control of the project and transferred further activity to Japan last year. The English-Japanese version is being marketed and is in active production in a Tokyo translation services bureau. The Japanese-English version requires additional development which IONA states it will begin in the near future. I have personally observed this system and consider it to have excellent potential for achieving effective operation.

In addition to the Weidner systems, implemented on minicomputers which limits their production rate, Bravice has announced that it will soon market an expanded version designed to run on mid- and large-scale machines. As far as I was able to learn, when I was in Tokyo in April, marketing had not yet commenced.

In addition to these systems, most of the larger Japanese computer manufacturers have announced, but have not yet begun to market machine-assisted translation systems. These include Fujitsu, Hitachi and Nippon Electric. Of these projects, the Hitachi Atlas II system seems closer to fruition. Based on discussions in Japan, particularly with persons in the US Embassy who had personal contact with Fujitsu officials, I learned that Fujitsu had recently moved this development from their research and development division to their translation department and are beginning to use it for the production of translations for internal corporate purposes. Its announced characteristics are impressive for an initial development, but it has one distinct disadvantage, particularly for any proposed application in this country. This is that it reportedly requires a substantial amount of pre-editing of the text in that clause boundary markers must be inserted in the text of complex sentences.

To my prepared remarks I have attached a chart giving the most significant announced details concerning virtually all of the large-scale system developments in Japan.

Based upon what I have learned, I have reached certain conclusions which I would like to share with this subcommittee. While there is no lodestone yet in sight which can be used to readily transmute the large and growing volume of Japanese scientific and technical literature into a form readily usable by the English speaking audience, great progress has been made in machine-assisted translation in general and in its application to Japanese in particular. Given the growing importance of access to Japanese scientific and technical literature it would be unwise for the US to adopt a posture of waiting and seeing if the Japanese will come up with solutions for our problems.

For these reasons the committee on which I have been serving has recently recommended the commencement of an interagency project to acquire a Japanese language machine-assisted translation capability for the US Government. If possible, this will be built around one of the systems already in an advanced stage of development.

All involved realize that no quick and easy solution to the problem is yet at hand and that a substantial initial investment will be required before dividends can be expected. Despite the difficulties in the way, our success with the Russian system at FTD and my evaluation of the Systran and Weidner Japanese systems has convinced me that the problem is not insoluble and that, given time and a reasonable investment of resources, machine-assisted translation can make a substantial contribution toward the goal of improving our access to Japanese scientific and technical literature.

Attachment to Testimony of George W. Rogers, Jr., before Subcommittee on Science, Research and Technology, Committee on Science and Technology, U.S. House of Representatives

ANNOUNCED SPECIFICATIONS OF JAPANESE-ENGLISH TRANSLATION SYSTEMS

Manufacturers	Systran	Fujitsu	Hitachi	Bravice	Bravice	NEC	Mitsubishi
Names of systems	JESS	Atlas II	Athene N	Pak 11/73/80 Pak 11/73/40		PIVOT	
Words in dictionary	30,000	50,000 (basic) 25,000 (S&T)	10,000 (basic & S&T)	40,000 (basic)	100,000	50,000 (basic) 50,000-60,000 (manuals) 20,000-30,000 (glossaries)	
Translation speed (words per hour)	300,000	60,000	60,000	3,000 (73/80) 2,000 (73/40)	60,000-80,000	100,000	20,000
Accompanying computers	Mid-range IBM	FACOM M 430R FACOM M380H Mid-range	HITAC M-280H Mid-range	16-bit mini-computers	Large computers	ACOS-6/MVX -4/MVP XE Mid-range	Large computers
Marketing date	?	June 1985		June 1984	Early 1985 ?	Dec 1985	Fall 1985

Mr. WALGREN. Thank you very much and I will ask the staff to take excerpt of this and include it in the record for people who might like to see that and make that comparison.

[The information follows:]

51-564 O—85——4

Translated excerpt from Soviet Book, Problems of Machine Translation, by Yu. N. Marchuk, Moscow, 1983.

DOC = SYSTRAN PAGE 1

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APPENDIX 1.

In appendix 1 is given description of several operational systems of machine translation/conversion, utilized in informational service of specialists with translations from foreign languages.

1. System of machine translation/conversion "SYSTRAN".

On 26 May, 1978, in New York at the United Nations took place a meeting of specialists in questions of machine translation/conversion [MP]. Was presented SYSTRAN system of MP with editing, which is the property/ownership of the company World Translation of Canada. Dr. Peter Toma is the scientific head of system. As large stimulus for the development of system served the flight of Apollo-Soyuz, in course of which the system of English-Russian and Russian-English MP was realized. During the flight a large quantity of texts was translated, with total volume of tens of millions of words, in both directions. The commercial operation of system was begun in 1975, when the system of English-French and French-English translation/conversion began to operate. It is actively used and financed by General Motors for the translation of the technical

descriptions of tractor technology, including especially military.

The advantages of the system:

- the obtained text can undergo editing easily and rapidly;

- has the capability to convert the large capacity of scientific and technical materials;

- system "is multilingual";

- engineering decisions are sufficiently simple (standard computers).

One of the main advantages consists in the fact that with MP the observance of consistent, noncontradictory terminology is provided, while in the human translation/conversion of terminological vocabulary disagreement frequently appear. This advantage is very essential for a scientific-technical translation/conversion. General Motors considers it fundamental in the selection of precisely MP for the translation/conversion of specifications (Segeda, Levesque, 1977).

The rate of conversion is 1 mln. words an hour for the operating

time of central processor. The rate of editing - 10 thousand words an hour, so that it is convenient to have five concurrently working editors. For the transition to a real-time informational system it is necessary simply to increase the quantity of editors.

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Cost/value of machine time is 1.4 cents/word with a file of 40-50 thousand words, which is very good index.

The system provides the correct translation/conversion of diagrams, charts, and other nontext inclusions. In the computer(s) the changes can be input/embedded, for example, with standard changes to the terminology. The corrections of editors also gradually are accumulated and are input/embedded into the dictionary. Translation/conversion is carried out for the following pairs of languages: English-French, Russian-English, English-Russian; during 1978 English-Spanish, French-English, English-Arabic systems were put into operation. The system of translation from the Chinese language has been created. For this language the input/introduction of text does not present difficulties, since it is carried out using Chinese telegraphic code, which at the same time provides easy recognition of homography.

The edited text of translation/conversion, ready for reproduction, is carried out with the speed of more than 10,000 words per day. This is five times faster than the ordinary norms of the translation/conversion of scientific-technical material. One coder can on the average introduce into the lexical base of the system 150 new units. If translation/conversion is intended for the printing, then considerable savings because of the use of devices/equipment of photo-output is reached. Processing of 1,000,000 words per month requires less than 5% power of a machine of the type of IBM 370/168.

The Russian-English system is the most developed. Three hundred thousand words and expressions are "on-line" with the computer. The European Economic Community uses a number of SYSTRAN subsystems in Luxemburg on agricultural texts. In San Diego two colleagues are working on an English-Italian system. The English-French bank of lexical data toward the end of the current year will reach 200,000 words; in essence this is a technical dictionary. In the zone, adjacent to the territory of General Motors, is provided the output of lexical references to translators on a real-time scale through a computer-informational network/grid with video terminals.

In the beginning of the 80's the company intends to carry out translation/conversion within the limits of all pairs of languages of the countries of the European Economic Community.

Areas of science and technology, in which translations/conversions are done:

- motor vehicle and food industry;

- computer technology;

- communication;

- aeronautics, electronic engineering, engineering, administrative questions and so forth. The system of control/checking of the quality of translation/conversion makes it possible to keep careful account of the changes introduced.

The efficiency/cost-effectiveness of system is provided by the combination of machine and human labor/work, by a decrease in the number of errors. The economic effectiveness of SYSTRAN is interesting.

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In 1978 the European Economic Community conducted an estimation of

economic effectiveness based on materials of the carried out translations/conversions. SYISTRAN was evaluated in two aspects: a) the speed and cost/value of translation/conversion; b) the quality of translation/conversion. Checking was carried out on the translations/conversions from English to French of texts on the food industry and technology. The file of texts included: 20 abstracts of texts on food industry and technology from journal of abstracts, with a volume of nearly 3000 words; two articles from scientific journals, with a volume of nearly 4000 words; 4 documents of the EEC, with a volume of about 4200 words. The used dictionary contained approximately/exemplarily 25 thousand words (word forms) and 4500 expressions. Checking was carried out on an IBM computer with dictionary update after the first run. Simultaneously the Department of translations/conversions of the EEC translated the same texts manually, with editing, and edited the obtained computer texts after the first run (Chaumier, 1977).

Let us briefly examine the history of the development and the principles of the linguistic device/equipment of SYSTRAN. Judging by the publications and bibliographic references, at the beginning of development the prototype of system SYSTRAN was connected with Georgetown University (Toma, 1974). One of the first versions of system was named SERNA (system of translation from Russian into English) and on 8 June, 1959, it was demonstrated at the Pentagon

(Toma, 1977). Since at least 1970 the system has been used for technical translations from Russian into English at the Foreign Technology Division of the USAF at Wright-Patterson Air Force Base in San Diego, California [sic! don't we wish]. Present version Dr. P. Toma names the third generation of the system SERNA.

The linguistic software of the system is described in extremely general/common/total expressions. It should be noted that while Dr. P. Toma in two articles makes respectful references to the transformational grammar and in-depth structures of N. Chomsky, the representatives of SYSTRAN in New York, D. Allen and D. Berden, have indicated that the semantic structures of N. Chomsky and his methods of conversions are not used in practice in the system. This is confirmed also by the discussion of the operating principles of the system in 1976 (Chapin, 1976).

P. Toma describes the linguistic bases of system as follows. The most important group of programs analyzes the sentence of the source language and establishes in it syntactic and semantic relations between its parts. These programs compose the recognition grammar of the system, whose fundamental parameters are determined by laws governing the input language. The analytical component of this grammar determines the functions of each word in the sentence and writes/records this information in special codes. Independent of the

analyzed language, these codes indicate the same syntactic relations: thus, Russian, Chinese or German verbs will always indicate their object in specific bits of the cell, and for all languages these bits will be the same.

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The connection between the subject and the predicate also is written/recorded in specific bits. In the process of development of a system for the translation from the Russian, Chinese and German languages it became clear that the theory of linguistic universalities is actually/really the reflection of objective reality and in this respect allows/assumes practical use. The most obvious confirmation of this is the fact that the identical types of syntactic relations (parts of the sentence) can be identified in each of the named languages. The algorithms of analysis, which determine these relations, are based on the contextual information included within the sentence bounds, simple or additional within complex. The system of syntactic analysis carries out the classification of sentences into main, auxiliary, types of auxiliary, and so forth.

For recognition of the elements of a sentence the programs of initial linguistic analysis use the lexical information which is attached to each word in the dictionary. This information is used

after the permission/resolution of homography. Each lexical item has a set of signs/criteria which characterize the part of the speech of the word, its particular control characteristics, semantic properties, homographic nature, etc.

Particular attention was paid to the compilation of the dictionary. The compilers of the dictionary used the most diverse sources; however, its use in text was the principal criterion for describing the word. Dictionary was specially corrected based on the results of experimental translations/conversions; the lexical item was compiled with the use of the principle of feedback. As a result of the careful study of the text behavior of words it is possible to assign to words a number of diverse functional signs/criteria (semantic categories, such as "measure", "motion", "chemical process"; the signs/criteria of control and matching, etc.).

The following comprehensive quotation gives an idea about the style of the description of linguistic software and about the principles which lie at the basis of the latter. "During compilation of the program for recognizing syntactic relations the linguist/programmersoon is convinced that school-book grammars are completely insufficient. Since the program or procedure must be compiled by a human, i.e. speaking-listening (or, more accurate, writing-listening), the program unavoidably becomes the means which

gives the possibility to a machine to reproduce, to a certain extent, human behavior in this process. In this respect Chomsky's arguments, which use lingual behavior (performance) as certain initial information (including data provided by introspection), become very important for the linguist/programmer who develops/processes translation from Russian into English, who can, for example, ask himself: "How do I know that this is the construction/design "чем...тем" and that "тем" in this case does not indicate an oblique form of "это", etc.

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When he begins to investigate this problem, he sees that this initial question leads to fifteen or twenty other questions, with the aid of which the problem is expanded in certain logical steps. His program will consist of necessary questions relative to the given construction/design; alternative responses will lead to individual subroutines within the program. Besides the definition/determination of the fact that was actually/really encountered the construction/design "чем...тем"... the program must establish/install the specific designations which indicate relations between the sentences which begin with "чем" and "тем", establish/install relations within the sentences, and prepare the entire construction/design for the equivalent translation/conversion with

the aid of the appropriate English structure. Thus, the program finds the system of codes, with the aid of which in several seconds will work the general routine of translation/conversion and English synthesis.

New achievements of linguistic thought and theory can sometimes prove to be extremely useful in linguistic programming (possibly, because of this, becoming excessively practical and uninteresting in the eyes of the theoretical linguist)" (Toma, 1974, 162).

From this description it is possible to draw the following conclusions:

- linguistic description is isolated from the algorithm only to the most necessary, most likely minimum, degree;

- compilation of a linguistic algorithm is closely related to programming. Optimum coding and the sequence of linguistic operations/processes form the basis for compilation of the procedure of analysis;

- algorithm is binary by its logical nature and is oriented to the output language. Its "universality" has a purely technical character.

The linguistic analyzer of SYSTRAN consists of the following four basic stages. The first stage resolves homography. The second investigates the sentence from right to left, memorizing, upon transfer from one word to the next, what types of syntactic relations are potentially possible within each autonomous sentence, if we consider the types of words encountered. Using a set of registers, in which data about the possible types of syntactic relations are contained, this stage then establishes/installs basic structures within the sentence (verb plus object, pretext/preposition plus object, etc.). The third stage, moving from left to right, more precisely formulates these relations, identifying the types of objects, determining structures, and so forth.

The fourth stage, using the data obtained as a result of the work of the previous stages, including information about the sentence bounds, the types of principal and dependent sentences, performs analysis within the limits of these sentences, determining the subject and predicate in each of these sentences.

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In each SYSTRAN system are also hundreds of special lexical

procedures, based on study of the characteristics of the lexical behavior of units in the source language. These lexical procedures are carried out after the four basic stages of analysis, but before synthesis and before realization of the necessary transformations of the syntactic structures of sentences in the target language. Syrthesis programs provide construction of a correct lexical equivalent in the output language (root plus necessary suffixes and endings, and also prepositions, where required) for each translated word. The special programs for the transformations of structures provide the necessary transformations of the structures of sentences so that the sentence would take the form natural for the output language.

It should be noted that in certain cases the information can be transmitted from one sentence to another. The special place for this information is reserved in the computer memory. It is especially necessary for the translation/conversion of pronouns whose antecedents can be located in another sentence.

In the course of translation/conversion the necessary conversion/transfer transformations can be carried out at different levels. Each given transformation can affect one lexical unit, phraseological expression, subordinate clause, or, in certain cases, it can fall outside the bounds of one sentence. SYSTRAN, according to

the claims of the authors of the publications, has practically unlimited transformational possibilities, which is its distinctive feature as a third-generation system.

A feature of the system is the ability to resolve ambiguity at different levels, including the dictionary level. This ability to resolve ambiguity can be considerably increased by the addition of new procedures without a change in the fundamental algorithm.

For the permission/resolution of lexical polysemy, several methods are envisaged. Introduction and use of semantic signs/criteria is one of them. Since the semantic codes are assigned to the words of input language, the problem of ambiguity actually is resolved at the level of this language and synthesis in any other language can thus be based on the results of the permission/resolution of ambiguity in the input language. The translation/conversion of pretexts/prepositions is the single exception/elimination to this rule.

The organization of the dictionary item in SYSTRAN makes it possible to unlimitedly supplement it with new information.

Especially should be noted the methods of using the semantic information. For SYSTRAN were developed 300 semantic categories

(signs/criteria).

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These categories were obtained by empiricism, i.e., virtually during the work of system. The empirical production/consumption/generation of categories based on text has a number of advantages over the theoretical compilation of a set of such categories, since in the first case their wide and general-purpose use/application is guaranteed. Important moment/factor in this respect is also the fact that these categories are used at the level of the analysis of the input language. This gives rise to their applicability to translation from various languages or from one language into many. Virtually any pragmatic information can also be attached to the lexical units or to the word combinations.

The creation of software is of great, if not decisive, importance. Virtually any publication on SYSTRAN begins with software. It is asserted, that the development of this software was the most labor-consuming part of the work and that on its execution many years and hundreds of hours of machine time were spent. "Eight years of scientific research work and realizations of the systems of the first and second generation convinced me, in 1964, of the fact that the basis for a large, general-purpose suitable system of

machine translation/conversion must be the thoroughly thought-out, general-purpose software, which could embody all necessary components of the system of machine translation/conversion. In the course of development it became clear that the main programs must be written in the language closest to the language of machine, i.e. in assembler" (Toma 1977, 571). The fundamental tasks executed by the general-purpose software of SYSTRAN are as follows:

- reading of text;

- breakdown of text into words;

- search for words in different dictionaries;

- adding the lexical codes to words or to the word combinations of the text;

- memory allocation for the analyzed sentences;

- control/checking of the execution of the programs of translation/conversion;

- preparation for translation/conversion for printing, output to microfiche, etc.

The fundamental software of SYSTRAN is supplemented by different single programs and subprograms, which realize the particular tasks and tasks of stages. Thus, specific routines provide dictionary update, auxiliary types of work with the dictionaries (compilation of concordances and the like, the study of diagnostic material, etc.).

The input/introduction of text for the translation/conversion can be realized with the aid of the most varied devices/equipment (from punched tape, punched cards, from optical reading device/equipment. The question about oral input/introduction was also examined; however, here concrete/specific/actual results have not yet been achieved/reached). The text passes through the computer and the result is output either to print or to the device/equipment of photo-output for the insertion of charts, diagrams, etc.

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The translated sentences are called up on the screen of the display, where a post-editor edits it, if necessary; it is then sent to output (printout on paper, microfiche, etc.). The corrections introduced by the editor are automatically accumulated and are then given to linguists for the introduction of changes into the system. SYSTRAN

provides linguists with a large volume of information in the form of concordances and special dictionaries, in order to rate/estimate the abundance and type of one or another syntactic and semantic phenomenon in a most careful manner before making a decision about its inclusion in the translation system.

The program of search in the dictionary works as follovs. As soon as text is introduced into the machine, each word is compared with the data which are contained in the special table of the most frequent words. After the finding of the word in the table, to the word of text is assigned a number, in which is contained the indication of the address by which the information to this word is assigned. In the special table of information, which is called into the working storage, all necessary information of grammatical and semantic character of the basic highest-frequency words is contained. The words of lov frequency, which are absent in this table, are sorted in the same order in which is constructed the fundamental file of dictionary, and then they appear themselves in the dictionary. The main dictionary for the search is ordered by the lengths of the roots of the words; however, this is important only for inflected languages such as Russian. For other languages another procedure is used.

Each program of the translation system is called by the controlling program and is input/embedded into the working storage as

needed. Control of the call of programs is fully automatic; in other words, as soon as text is introduced into the computer and the program of control begins to work, SYSTRAN independently passes from one stage of the process of translation/conversion to another and consistently is carried out entire process, from the dictionary search to the analysis of input text and synthesis of output.

For the analysis, in the storage special zone is reserved. The results of analysis are written/recorded in a special interlingua. Development of this interlingua gives the possibility to convert immediately to several languages.

In the zone of analysis to each word are assigned 160 bytes. Of them, part contains lexical information, in others - the information obtained during the work of the stages of analysis is written/recorded. Thus, information with each word form contains syntactic and semantic data, obtained both from the dictionary contained in the computer and as a result of the analysis of input text by the programs of stages. The special codes of SYSTRAN assigned to the individual words, and also to phrases, include vast semantic and syntactic information about each word and its interactions with other words of the sentence.

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Into the latter enter such wide traditional concepts as direct and indirect objects, and also such nuances as the type of subject or object preferred by the given verb. As noted above, general/common/total syntactic characteristics for all languages, converted by SYSTRAN, are written/recorded in the same places of the cells and are expressed in the identical codes. This provides the suitability of the system for the different languages.

The software of the system makes it possible to ensure a rate of translation/conversion of 200,000-300,000 words an hour.

end.

Mr. WALGREN. Let me ask a general question of the witnesses as each of you have a different piece of this puzzle. You heard Senator Rockefeller say that he would like to see the Federal Government establish some kind of a translation effort in this area; perhaps a technical information service that would be focused on Japanese literature. I realize you can't get much for the amount of money that everyone's talking about, but nonetheless, he felt it important to make that kind of a concrete start.

Can I ask you to comment on whether you think it is the best first step that we can take. Are there blue-ribbon panels that would like to make suggestions about other things that the Congress or the Federal Government should think about as a constructive first step or would something grow from this, that we feel would be effective much along the lines of the Japanese Government having a focused outreach in technical areas?

Dr. Strull.

Dr. STRULL. I think I would modify the remarks to look at Japanese information, rather than Japanese translation. I've learned there is a tremendous amount of Japanese information in English available in Japan that we never see. I happen to be in defense and I found a remarkable publication printed by JDA called "Defense of Japan," printed in English with a great deal of information. I find very few people know it existed. I was lucky to get ahold of it.

There is a book that comes out every year called "Industrial Groupings in Japan." It is as big as the New York phone book, which lists all the Japanese mafia—I like to refer to it as—the first-tier firms, second-tier firms, third-tier firms and all the groups so you can find who really belongs to whom.

So that a good starting point is to start with getting the English information we have available and then follow it up with translating those things that we can't get ahold of, especially in manufacturing information.

Mr. WALGREN. Ms. Hubbard.

Ms. HUBBARD. At the risk of perhaps not getting out of here alive, I would like to say—to suggest that perhaps the $500,000—if we are talking about that finite amount of money—might be used to develop a plan; $500,000 is not going to really accomplish too much. There are some innovative things going on. Dr. Daub has a program at Wisconsin and so forth.

I think that we need to identify the barriers. I have, for example, just been informed—and it is informally and I can't give you concrete information, but there may be some disincentives, even in the accrediting board for engineering in the country here to study Japanese. Those are the kinds of things that don't cost a lot of money to turn around. They need to be positioned in light of, again, a national consensus that Japanese lanuage training is important.

I have also been told that at one time in this country German language was required for engineering. Perhaps those of you who are engineers can comment on that, but I think there are policies that could be fostered by really examining the barriers, examining what is out there and promoting those which will address the problem.

So the blue-ribbon committee isn't a bad idea.

Mr. WALGREN. Other thoughts on that subject?

Dr. DAUB. I would like to say one thing that also came up at this conference at the Bureau of Standards, people always talk about translating. I favor the development of people in our country who can comprehend technical Japanese and cull from a Japanese article the nuggets of information their colleagues want. Therefore, I think we have to invest some of that money in summer intensive courses in technical Japanese at certain locations because not every university is going to be able to offer that subject.

The other thing is that, as was suggested here, you have to evaluate what you are going to translate and the only thing that should be translated is something that has already been assessed and, therefore, just the translation program might not do it.

What you also should watch for, what the success is going to be for this university microfilm project originally started by Xerox called JTIS, Japanese Technical Information Service. They advertised it at the NBS meeting these past few days. If you invest $5,000, you get their publication covering abstracts in about 1,000 Japanese journals that they have screened as being the most important Japanese journals. Perhaps some support should go there although that is a private venture. They say they have calculated they are going to have losses the first number of years of operation until its takes hold.

Mr. WALGREN. Other thoughts?

Dr. STRULL. I really applaud those remarks about interpretation. In getting ready for this hearing, I talked to some of my colleagues and we talked about integrated circuit manufacturing, which is very complex, and the problem of second-sourcing. In the early days of the technology, a great deal of information was passed from firm to firm, but it was determined that that wasn't sufficient to really manufacture the same devices and now the way it's done is that firm A goes to firm B's plant, firm B goes to firm A's plant, so here I'm talking about integrated circuits; I'm talking about two firms that speak English and they can't understand each other enough to replicate a device without the hands-on, person-to-person.

So I want to add that nuance.

Mr. WALGREN. What I seem to be getting from all your thoughts is that the Japanese language is not beyond the reach of an American engineer or scientist to learn to read. I had assumed that it was something that would take substantially more than short-term courses; and yet what I hear is that it may not be really beyond our reach to get a substantial number of people interested and at least reading the language.

Dr. STRULL. But the key is comprehension. I really want to applaud that remark.

Mr. WALGREN. I see.

Dr. STRULL. Reading it isn't really enough, and it is so wrapped up in the culture of the people that even when we think we know something, it comes out a little different. I just want to say to those who understand, no explanation is necessary; to those who don't, none will suffice. This is about the only way I know how to put it.

Dr. DAUB. I think you have to realize that most of the information will come from Japanese linguists who are humanists and not scientists; who don't realize that even in our own English language,

scientific terminology and grammar are really a small subset of our language, and I heard yesterday from a member of the Japanese linguistic community that it takes 4 years before you can become a Japanese translator. That is absolutely not true in the technical field and most of those people have not taught technical Japanese.

There is a group at the National Bureau of Standards working with our book, working through it on their own with assistance from a few visiting Japanese and proceeding very ably and very well, but what we want to do now will not even assume that they have had first-year Japanese, which will be a tougher one to produce, but which will be a great success if we can do it.

Mr. WALGREN. I know Mr. Boehlert wants to ask a question in this area and I don't want to dominate the time completely, but is there government help for developing those kinds of materials? Let me ask two questions. One is, how few people have gone through this kind of training? Are we talking about 50, or 100 in this kind of short-term Japanese technical language capability development?

Dr. STRULL. I would estimate we're talking about 30 to 50 people. We have had 12 so far; the exchange program is recent. There have been—oh, on the order of 200 to 300 Japanese engineers who come to the United States, going back many years—and only in the last few years have we had the reciprocal exchange where we have come there.

Mr. WALGREN. I see.

Dr. STRULL. I will say we are welcome. The point made by someone much earlier, it isn't a question of Japanese trying to keep secrets. We don't have that particular problem, as we do in Russia. They are more than willing to talk about what they do. We just don't seem to understand—I should ask for a disclaimer for my remarks lest I carry them too far. When I gave my comments, I said I was going to talk about integrated circuits and related technologies. That is where my familiarity lies.

In that particular area, all the design is done in English. In Japan, the design terminals are all English character, English symbols on the screen. All of the processing equipment, even that manufactured in Japan, all has English labeling as to where the switches are and all the dials—all the gauges, all read in English. The process specifications, the gases, all in English.

So that's kind of where I am coming from when I say that's not as important as the culture and the lead time. However, in machine tools, in other fields, in composites, I don't know—I'm talking about integrated circuits so I don't really want my remarks to pervade the entire field of competitiveness. I really want to add that disclaimer.

Mr. WALGREN. But the number of people who have been reached by Dr. Daub's course is only a handful at this point?

Dr. DAUB. I would say we've only had it in the curriculum for the last years because the usual language programs don't like practically oriented courses, but we did manage to get it through because they had a French business course. We have had now, I would say, a dozen. We hope this certificate, advertising it, would bring on more. Enrollment in the beginning courses has gone up to

about 75. So we have high enrollments in Japanese, but not many scientists and engineers yet taking it.

Mr. WALGREN. I see.

Ms. Hubbard.

Ms. HUBBARD. Six of our students got through Cornell last year and four of the current five have just begun Berkeley. They have had 2 weeks and they're still there to everyone's surprise. We did a study at AEA last year and asked some of our subsidiaries over there if they were providing Japanese language training to their employees who worked in Japan—and by the way, for these 6,517 Japanese-based employees, there are only an average 2 United States citizens in companies over there. That is on the average, so there are not very many United States people in Japan, even in joint ventures. They hire—tend to hire local people, but I just noted that 53 employees from 23 companies in Japan received some form of Japanese language training in 1984. So I think probably some of it is going on. It is not necessarily technical, per se, as Dr. Daub is trying to do. We sort of take those who have gotten through the system and now are trying to put them back. Age does appear to be a factor, though, I have been told.

Mr. WALGREN. The Chair recognizes Mr. Boehlert.

Mr. BOEHLERT. Thank you, Mr. Chairman.

I have an opening statement and I ask unanimous consent that it be inserted in the record immediately following yours.

Ms. Hubbard, what has been the response from the National Science Foundation to your request for a challenge grant to AEA?

Ms. HUBBARD. They have been very cooperative. The only problem is, of course, is it takes lead time to do it. I needed the challenge grant this year since I was trying to get this fledgling program off the ground. There has been receptivity, but silence, if I may say.

Mr. BOEHLERT. Well, I——

Ms. HUBBARD. I have no money and no commitment, but I'm encouraged. I have no rejection.

Mr. BOEHLERT. Well, if you were projecting a time period, what would you say?

Ms. HUBBARD. I hope that——

Mr. BOEHLERT. Are you getting closer?

Ms. HUBBARD. I hope that—I hope that we'll be there by next year, yes.

Mr. BOEHLERT. I would suggest that the chairman and I would be more than willing to be intermediaries——

Ms. HUBBARD. Thank you very much.

Mr. BOEHLERT [continuing]. And advocates for you in this thing.

Ms. HUBBARD. Thank you.

Mr. BOEHLERT. Professor Daub, did I understand you correctly, the University of Wisconsin is the only university——

Dr. DAUB. That is the report that was given at the Wilson Center by Professors Sam Coleman at North Carolina State and Richard Samuels at Massachusetts Institute of Technology who surveyed the whole country and told us that. We were proud to know we were the only one, but also sorry to hear that——

Mr. BOEHLERT. So am I.

Ms. Hubbard, didn't you say your AEA people went to Cornell?

Ms. HUBBARD. They have been to Cornell, and they have been to Berkeley, but the curriculum is not focused on technical Japanese.

Dr. DAUB. They are just learning beginning Japanese.

Ms. HUBBARD. It keeps them from being called barbarians when they go.

Mr. BOEHLERT. Dr. Strull, you mentioned Professor Frey at Cornell who happens to be one of those who were involved in the program that Ms. Hubbard mentioned. He's over in Japan right now and that's the type of thing that I would like to see more of and I'm sure you would also. How do we encourage more activity like——

Dr. STRULL. Well, he had a 1-year sabbatical.

Mr. BOEHLERT. Paid for by—is it Cornell?

Dr. STRULL. I guess; I don't know. It wasn't SRC; SRC took advantage of it. I know it wasn't paid by SRC; they took advantage of his presence. I don't know who paid for it.

Ms. HUBBARD. We paid for part of it.

Dr. STRULL. You paid for part of it? OK, all right.

As a member company in SRC, we get this Frey report from Japan, which I am going to leave with the staff, and it is an outstanding document. At the last SRC meeting which was held, I think, June 2d and 3rd in Orlando, we were discussing the fact that his sabbatical was coming to an end and several of us from various firms were discussing with the Director of SRC some ways to perpetuate that sort of an activity and I made some suggestions and so did others and it is being examined.

Mr. BOEHLERT. Ms. Hubbard?

Ms. HUBBARD. May I comment? My understanding is that MITI has a fund now to bring some of our engineering faculty over to Japan. I know that Professor Merz from UC Santa Barbara is going. Hitachi has approached AEA and asked that it facilitate sabbatical engineering professors to Japan. It is an interesting question because—perhaps you missed my opening remarks, but we have a very severe shortage of engineering faculty here right now——

Mr. BOEHLERT. I understand that.

Ms. HUBBARD [continuing]. And what would be ideal, perhaps, would be to take students, graduate students who intend to be teachers—there are not that many, and provide them with this experience. We have one out of the six of our students who is intending to teach, so, perhaps that population might be a good target.

Mr. BOEHLERT. Well, you know, we've just been responsible for setting up some of these engineering research centers—I think there are going to be six set up throughout the country—and are we missing the boat? Should we require something in terms of foreign language aspect of those engineering centers?

Ms. HUBBARD. I think they would be ideal places to put some foreign language programs.

Mr. BOEHLERT. They are not—as I understand that, they are not even dealing with foreign languages.

Ms. HUBBARD. As far as I know, either. The only thing to keep in mind when we start requiring foreign language of engineering students, for example, is that the engineering curriculum is much impacted with courses now. The graduate level, it takes 3 years to get

an MS, 5 to 6 to get a Ph.D. and that's with just the current curriculum—now, if perhaps, Japanese language could be encouraged to be—again, I hope my social science teacher friends forgive me, but actually encouraging that as part of an elective, then we may accomplish the goal.

The need is there. There will be those to meet it.

Mr. BOEHLERT. Mr. Rogers, you mentioned the intriguing work done at RADC in terms of the Russian/English translation in machine-assisted translation. It is my understanding that work is still ongoing at RADC in this general area. Am I correct or———

Mr. ROGERS. I think that they had some work going on, but I am not sure that—I don't believe there is any current work going on at RADC. I think that in following your suggestion that there might still be some research type activity which would be useful in the field. However, as I think I tried to indicate, the technology has really gotten out of the laboratory to a certain extent, and may I say this, if you are interested in the subject, you can do so much with a machine translation capability in the laboratory—you know, in the research and the development phase, but it is not going to be a very useful tool. It's got to learn, and the only way for the machine to learn is to do translations of the type you want it to make through it and spend a lot of time and upfront investment building the dictionaries, the term expressions and, particularly, the idiomatic idiosyncracies of what you're trying to translate into the machine and you can't do that in the laboratory, in the development facility.

You have got to have a fairly crude model, the best you can get, put it on the floor and start making translations.

Mr. BOEHLERT. Near the conclusion of your testimony, you talked about the committee that you are serving on which has recently recommended the commencement of an interagency project———

Mr. ROGERS. Yes.

Mr. BOEHLERT [continuing]. To require a Japanese language machine-assisted translation. In view of the great success at RADC and FTD with the Russian/English, wouldn't you be looking in that direction where we have already enjoyed a success, where we collectively———

Mr. ROGERS. Yes, sir. The———

Mr. BOEHLERT. I don't mean to be parochial because I———

Mr. ROGERS. I would say that we are looking in that direction, actually the process of trying to decide who's going to be the lead agency and who's going to fund it and what horse we're going to ride specifically still has yet to be played out.

Mr. BOEHLERT. I am somewhat prejudiced, for the record, about RADC. It happens to be in my district.

Mr. ROGERS. I see.

Mr. BOEHLERT. And I know the great work that———

Mr. ROGERS. Well, they have done a lot of good work, particularly for the Department of Defense and they were highly instrumental in getting this started—this particular Russian/English system started and implemented.

Mr. BOEHLERT. I would enjoy pursuing this further with you after this hearing.

Mr. ROGERS. Yes, sir.

Mr. BOEHLERT. Thank you very much.

Thank you, Mr. Chairman.

Mr. WALGREN. Call on Mr. Ritter.

Mr. RITTER. Thank you, Mr. Chairman.

I appreciate your calling this hearing. I think it is important that we go from the iterative statements of the problem to what we want to do about it in terms of trade deficit and terms of understanding more about Japan and getting deeper into Japanese markets with American products.

I would like to just throw something out. In the 1950's, when we perceived a major Soviet threat in geopolitical terms and strategic terms, we responded and we set up a whole host of Russian language training centers at our major universities. We built those that already existed into bigger ones.

Is there rationale for doing something like this regarding Japanese language literature, culture, and the like? Pat Hubbard quoted a Mr. Gresser saying that the Japan industrial challenge was like—on an economic ground—was like the East-West challenge on a geopolitical ground. Should we be thinking along those lines? I'd like, maybe, Dr. Strull, if you could——

Dr. STRULL. Yes, let me make a remark, if I can pick up on that, comparing Russia to Japan. I was talking last week with a Japanese executive who was visiting me. I have met him several times before, and I asked him about Japanese publication versus English publications, to get some insight.

He says, "Everybody in his division prefers to publish in English. They only get recognition when they publish in English. That is where the posh is." There are many, many more readers worldwide in English than in Japanese, so that they publish their work for the first time, their innovative work, in English before they publish it in Japanese.

Mr. RITTER. So that 25 percent of the publications that are done in English in Japan are—or the first 25 percent—is that hard data?

Dr. STRULL. No; earlier I cited the special issue of the electronic engineers on very large-scale integrated circuits in February, 40 percent of the papers in this journal are Japanese, published, most of them, probably, for the first time in this journal, not a Japanese journal. That remark on lead time I made earlier and that is why the comments of Dr. Daub are so significant.

They do something in a high-tech field and they have the symposium in Japan and they all get together and talk Japanese and you want to be sitting in the audience and getting it. Now, some months later, it's published and it might just as apt to be published in English or Japanese, but the Japanese manufacturers have all implemented it and we're just learning about it.

Mr. RITTER. OK, my question——

Dr. STRULL. In Russian?

Mr. RITTER. We faced—on the geopolitical field of the contest, we faced a challenge and we responded by generating a major national effort to learn Russian language, literature, art, culture, history through the Russian language centers of our great universities. We faced similar challenge in the economic and trade and industrial competitiveness grounds.

Should we be doing a similar thing? Ms. Hubbard, do you want to—that is the question. I don't think we've answered the question.

Dr. STRULL. No; I took too long. Yes, we should. The crux—and that is what I was starting to answer—the reason we haven't is because the Japanese publish extensively in English so we haven't felt the need. The Russians do not publish extensively in English and that's why we felt the need. Have I answered your question yet?

Mr. RITTER. I'm not just talking about technical publications here. I'm talking about transfer of ideas, information, cultural understanding, the things that allow you to be capable of doing business in a foreign land halfway around the world.

Dr. STRULL. I answer that, yes, we should.

Mr. RITTER. Pat Hubbard?

Ms. HUBBARD. I think yes and I would like to emphasize Dr. Strull's point about the symposium and the speed with which technology gets transferred into Japan and not the speed which we find out about it. That speed is a very, very important aspect of this picture.

I am—and I have heard from others—I just want to point out again that the distinction between translation and the ability to do business, to become part of a family, if you will, of at least people who are interested enough to learn about the Japanese and to break down some of those social barriers. We are never going to penetrate them totally, but we can certainly improve on our ability to design for the marketplace and understand the design. We all have anecdotes about it, but——

Mr. RITTER. Again, I'm going to go right back to a question. Given your preambles, how do you come down on——

Ms. HUBBARD. I guess I have heard mixed reviews about those Soviet language efforts and I am not sure that it takes the same kind of concentrated effort, but I think, indeed, it takes some significant effort. We need translators and we need to build into the system carrots that are going to encourage students to take Dr. Daub's course. All the courses in the world—we could set up an infrastructure like that and all of the new high-tech centers—there is no incentive for those students to take those courses. It won't happen.

Mr. RITTER. That's a good point. Is there a market for technically knowledgeable people who, with solid training in Japanese language and culture——

Ms. HUBBARD. Wish you hadn't asked me that. It is a mixed answer. We did this survey about asking companies over there and I would say that, again, if you look at the data, 60 percent say absolutely, 40 percent say——

Mr. RITTER. No; 60 percent didn't say actually. Thirteen percent said absolutely——

Ms. HUBBARD. Well, you're right——

Mr. RITTER. And 47 percent said infrequently.

Ms. HUBBARD. Some, uh-huh.

Mr. RITTER. So we are not sure that if people came through with this kind of training that they would have a job?

Ms. HUBBARD. I think that any engineer that takes the time and effort to study Japanese is going to have a job, whether or not that engineer is going to be paid more and whether that engineer is going to be sent to Japan right away, I don't know.

Our hope is——

Mr. RITTER. Is it just engineers that the problem——

Ms. HUBBARD. I focus on engineers. If you look at the interview I did with George Scalise of AMD, he is talking about lots of different kinds of people, personnel people, even, in Japan.

Mr. RITTER. Sales people.

Ms. HUBBARD. Sales people. If you look at, again, the data that responded, we have large sales forces over there.

Dr. STRULL. I don't know how pertinent this is, but I will relate it, as I think it has some bearing. We have Japanese nationals fluent in English in our Tokyo office. We have Americans who have learned Japanese, some of them quite fluently. When I look at the output, it is much more from the Japanese nationals. When I looked into this, and I have asked the Japanese, they like to talk to the Japanese because of the idioms, because of the culture, even if the Americans know Japanese. We've had people there for 15 years, but you don't really get immersed in the culture, so this makes it sound very bad.

It sounds like we can't really solve it, no matter how much we train them. There is this nuance I thought I should mention.

Mr. RITTER. Yes, sir; Professor Daub.

Dr. DAUB. I think one thing you should do with the Department of Commerce funds would be to have an orientation to Japan and basic conversational skills for every businessman who is trying to relate to the Japanese. I frequently have heard from Japanese friends in companies in Japan that they are very distressed that the Americans that come know absolutely nothing about the language. They don't expect them to be fluent; they don't expect them to carry on a complete conversation, but they expect some effort to communicate——

Mr. RITTER. Does that tend to breed some levels of disdain or contempt, even?

Dr. DAUB. Well, I think it suggests to them that we aren't giving adequate respect to their culture and language and I think that is very true.

Now, it doesn't mean they expect them to be as competent—and that's why I want to say the second thing. I don't think there should be a crash program in making all these Americans who can speak Japanese as fluently as Japanese can speak English and know everything from A to Z in physics and chemistry. I don't think they need that.

Mr. RITTER. I don't think there's a snowball's chance in hell of it happening.

Dr. DAUB. No, well, I don't think we need that because an interpreter, and in my remarks earlier, a translator, as I am talking about here is a person who goes from a written text and produces a written text, not somebody who interprets conversation. But interpreters are available in Japan and very easily. I have known company presidents in Japan who are better at English than their interpreters, but they will not speak in English and they will not serve in any way as an interpreter. They sit back and let the interpreter do it. The interpreter is not a decisionmaker, therefore, he is not really a highly valued person in the corporate structure in Japan and I don't think, therefore, we should try to make our deci-

sionmakers and highly skilled research scientists into that kind of mediator. But all of our research scientists who go to work in labs in Japan should have preparation, both in the technical language and in conversation just to be able to communicate with their colleagues, but never to think you're ever going to reach that level that apparently the Japanese linguists want with 4 years of Japanese.

Mr. RITTER. I guess when I look at the high schools, which is the basic training ground in this country for learning some second language, you find German and Spanish and French, very infrequently Russian. We don't have Japanese in but a few high schools all over the country. We——

Dr. DAUB. The Association of Teachers of Japanese in our country has just put together a list of the high schools. I received a copy that was put out at our university and there is a large number in New York State and California Hawaii and some others that are scattered about, so that list is available now so we could see where——

Mr. RITTER. We would like to have that for the record, if you would.

[The information follows:]

UNIVERSITY OF WISCONSIN–MADISON

COLLEGE OF ENGINEERING

Department of General Engineering
1527 University Avenue
Madison, Wisconsin 53706
Telephone: 608/262-2472

July 9, 1985

Ms. Carol Pompliano
Committee on Science and Technology
2319 Rayburn House Office Building
Washington, DC 20515

Dear Ms. Pompliano:

I recall that Mr. Ritter indicated he wanted the list of schools and teachers of Japanese, prepared by the Association of Teachers of Japanese, included as part of the record for the recent hearings. I enclose the copy that I mentioned during the discussion.

As the copy states, the ATJ does not claim that the list is complete. It represents those schools and teachers that have come to the attention of ATJ prior to July 1, 1985.

If this list is included in the record, the ATJ would appreciate mention of their wish to learn of other schools and teachers. Such information should be sent to:

Professor James O'Brien
President, Association of Teachers of Japanese
Department of East Asian Languages and Literature
University of Wisconsin
1220 Linden Drive
Madison, WI 53706

I hope that the hearings accomplished what Mr. Walgren and his staff had hoped. Please give my best regards to Tim Feinstein.

Sincerely,

Ed Daub

Edward E. Daub
Professor

Enc.

sjp

Teachers of Japanese--High School and Below
(As of July 1, 1985)

CA

Cerritos, CA

Joy Kawamoto
Cerritos High School
12500 E. 183rd St.
Cerritos, CA 90701
(213) 926-5566

Gardena, CA

Marvin Follett
Gardena High School
1301 W. 182nd St.
Gardena, CA 90428
(213) 327-5592

Evelyn Matsumoto
Amestoy Magnet Elem. School
1048 W. 149th St.
Gardena, CA 90247
(213) 327-5592

Chris Mayeda
Amestoy Magnet Elem. School
1048 W. 149th St.
Gardena, CA 90247
(213) 327-5592

Patsy Murakami
Amestoy Magnet Elem. School
1048 W. 149th St.
Gardena, CA 90247
(213) 327-5592

Cathy Reyes
Peary Junior High School
1415 W. Gardena Blvd.
Gardena, CA 90247
(213) 324-6606

Arlene Sakahara
Gardena High School
1301 W. 182nd St.
Gardena, CA 90248
(213) 327-5900

51-564 O—85——5

Laguna Niquel, CA

Jane Taniguchi
Niquel Hills Jr. High School
29070 Paso Escuela
Laguna Niquel, CA 92677
(714) 495-1051

Long Beach, CA

Michael Herrick
Polytechnic Senior H.S.
1600 Atlantic Ave.
Long Beach, CA 90813
(213) 591-0581

Los Angeles, CA

William Adams
Roosevelt High School
456 S. Mathews St.
Los Angeles, CA 90033
(213) 268-7241

Masako Kumazaki
U.S.-Jap. Cross Cult. Center
244 S. San Pedro St., Ste.305
Los Angeles, CA 90012
(213) 617-2039

Mountain View, CA

Hiroyoshi Taguchi
Language Pacifica
867 Dana St.
Mountain View, CA 94041

Palo Alto, CA

Miyeko Tanabe
Palo Alto High School
25 Churchill Ave.
Palo Alto, CA 94306
(415) 855-8186

San Francisco, CA

Ann Fujii
George Washington H.S.
600 32nd Ave.
San Francisco, CA 94121
(415) 387-0550

Richard Konopack
1451 Green St.
San Francisco, CA 94109

Ron Kunisaki
Clarendon Elementary
500 Clarendon Ave.
San Francisco, CA 94131
(415) 661-0770

Debbi MacKay
Clarendon Elementary
500 Clarendon Ave.
San Francisco, CA 94131
(415) 661-0770

Aileen Mizokami
Clarendon Elementary
500 Clarendon Ave.
San Francisco, CA 94131
(415) 661-0770

Char Mori
Clarendon Elementary
500 Clarendon Ave.
San Francisco, CA 94131
(415) 661-0770

Sumako Morimoto
Clarendon Elementary
500 Clarendon Ave.
San Francisco, CA 94131
(415) 661-0770

Junco Nerio
Clarendon Elementary
500 Clarendon Ave.
San Francisco, CA 94131
(415) 661-0770

Ann Shiratsuki
Clarendon Elementary
500 Clarendon Ave.
San Francisco, CA 94131
(415) 661-0770

Lei Yu Tiem
Galileo High School
1055 Bay St.
San Francisco, CA 94109
(415) 346-5043

Enid Yamamoto
Clarendon Elementary
500 Clarendon Ave.
San Francisco, CA 94131
(415) 661-0770

Torrance, CA

Christine Ito
North High School
3620 W. 182nd St.
Torrance, CA 90504
(213) 533-4412

HI

Aiea, HI

Chairman, F. Lang. Dept.
Aiea High School
98-1276 Ulune Street
Aiea, HI 96701

Chairman, F. Lang. Dept.
Aiea Intermediate School
99-600 Kulawea St.
Aiea, HI 96701

Ewa Beach, HI

Chairman, F. Lang. Dept.
Campbell High School
91-980 North Road
Ewa Beach, HI 96706

Hilo, HI

Chairman, F. Lang. Dept.
Hilo High School
556 Waianuenue Ave.
Hilo, HI 96720

Chairman, F. Lang. Dept.
Waiakea High School
155 Kawili St.
Hilo, HI 96720

Honolulu, HI

Chairman, F. Lang. Dept.
Kaiser High School
511 Lunalilo Home Road
Honolulu, HI 96825

Chairman, F. Lang. Dept.
Kawananakoa Intermed. School
49 Funchal St.
Honolulu, HI 96813

Chairman, F. Lang. Dept.
Roosevelt High School
1120 Nehoa St.
Honolulu, HI 96822

Chairman, F. Lang. Dept.
Kaimuki High School
2705 Kaimuki Ave.
Honolulu, HI 96816

Chairman, F. Lang. Dept.
Kalakaua Interm. School
821 Kalihi st.
Honolulu, HI 96819

Chairman, F. Lang. Dept.
McKinley High School
1039 S. King St.
Honolulu, HI 96814

Chairman, F. Lang. Dept.
Stevenson Interm. School
1202 Prospect St.
Honolulu, HI 96822

Chairman, F. Lang. Dept.
Radford High School
4361 Salt Lake Blvd.
Honolulu, HI 96818

Chairman, F. Lang. Dept.
Farrington High School
1504 N. King St.
Honolulu, HI 96817

Chairman, F. Lang. Dept.
Kaimuki Intermediate School
631 18th Ave.
Honolulu, HI 96816

Chairman, F. Lang. Dept.
Kalani High School
4680 Kalanianaole Hwy.
Honolulu, HI 96821

Chairman, F. Lang. Dept.
Niu Valley Interm. School
310 Halemaumau St.
Honolulu, HI 96821

Chairman, F. Lang. Dept.
Washington Interm. School
1633 S. King St.
Honolulu, HI 96814

Chairman, F. Lang. Dept.
Moanalua High School
2825 Ala Ilima St.
Honolulu, HI 96818

Kahului, HI

Chairman, F. Lang. Dept.
Maui High School
660 So. Lono Ave.
Kahului, HI 96732

Kailua, HI

Chairman, F. Lang. Dept.
Kailua High School
451 Ulumanu Drive
Kailua, HI 96734

Chairman, F. Lang. Dept.
Kalaheo High & Int. School
730 Iliaina Street
Kailua, HI 96734

Chairman, F. Lang. Dept.
Kailua Intermediate School
145 S. Kainalu Drive
Kailua, HI 96734

Kaneohe, HI

Chairman, F. Lang. Dept.
King Intermediate School
46-155 Kamehameha Hwy.
Kaneohe, HI 96744

Chairman, F. Lang. Dept.
Castle High School
45-386 Kaneohe Bay Drive
Kaneohe, HI 96744

Kapaa, HI

Chairman, F. Lang. Dept.
Kapaa High-Int. School
4695 Mailehuna Rd.
Kapaa, HI 96746

Kealakekua, HI

Chairman, F. Lang. Dept.
Konawaena Hi-Int. School
Box 698
Kealakekua, HI 96750

Lihue, HI

Chairman, F. Lang. Dept.
Kauai High-Inter. school
R.R. 1, Box 215
Lihue, HI 96766

Mililani, HI

Chairman, F. Lang. Dept.
Mililani High School
95-1200 Meheula Pkwy.
Mililani, HI 96789

Pahaha, HI

Chairman, F. Lang. Dept.
Kau High School
Box 218
Pahaha, HI 96777

Pearl City, HI

Chairman, F. Lang. Dept.
Pearl City High School
2100 Hookiekie St.
Pearl City, HI 96782

Wahiawa, HI

Chairman, F. Lang. Dept.
Leilehua High School
1515 California Ave.
Wahiawa, HI 96786

Waialua, HI

Chairman, F. Lang. Dept.
Waialua High & Inter. School
67-160 Farrington Hwy.
Waialua, HI 96791

Waianae, HI

Chairman, F. Lang. Dept.
Waianae High School
84-251 Farrington Hwy.
Waianae, HI 96792

Wailuku, HI

Chairman, F. Lang. Dept.
Baldwin High School
1650 Kaahumanu Ave.
Wailuku, HI 96793

Waimanalo, HI

Chairman, F. Lang. Dept.
Waimanalo Elem. & Int. School
41-1330 Kalanianaole Hwy.
Waimanalo, HI 96795

Waimea, HI

Chairman, F. Lang. Dept.
Waimea High-Int. School
Box 396
Waimea, HI 96796

Waipahu, HI

Chairman, F. Lang. Dept.
Waipahu High School
94-1211 Farrington Hwy.
Waipahu, HI 86797

IL

Chicago, IL

Mitsuhiro Umezu
6825 N. Sheridan Rd. #502
Chicago, IL 60626

Itsuko Mizuno
Murray Language Academy
5335 S. Kenwood Ave.
Chicago, IL 60615

MN

Golden Valley, MN

Yoshio Satoh
Breck School
123 Ottawa Avenue N
Golden Valley, MN 55427
(612) 379-1952

NC

Raleigh, NC

Mayumi Yamazawa
135 Salem Circle #A-3
Raleigh, NC 27609

NY

Albany, NY

Teruko Kusama
31 Iris Lane
Albany, NY 12205

Amityville, NY

Chairman, F. Lang. Dept.
Amityville Junior High School
Broadway
Amityville, NY 11701

Brooklyn, NY

Chairman, F. Lang. Dept.
P.S.117, F.S. Key J.H.S.
330 Willoughby Avenue
Brooklyn, NY 11205

Chiarman, F. Lang. Dept.
J. Wilson J. H. S., J.H.S. 211
1001 100th Street
Brooklyn, NY 11236

Curt Owens
970 E. 39th St.
Brooklyn, NY 11210

Central Valley, NY

Chairman, F. Lang. Dept.
Monroe-Woodbury Middle School
Route 32
Central Valley, NY 10917

Chester, NY

Chairman, F. Lang. Dept.
Chester Junior-Senior H.S.
Maple Avenue
Chester, NY 10918

Cold Spring Harbor, NY

Chairman, F. Lang. Dept.
Cold Spring Harbor H.S.
Turkey Lane
Cold Spring Harbor, NY 11724

Delanson, NY

Chairman, F. Lang. Dept.
Duanesburg Central School
Delanson, NY 12053

Elmira, NY

Chairman, F. Lang. Dept.
Ernie Davis School
East Clinton & Lake Streets
Elmira, NY 14901

Holbrook, NY

Chairman, F. Lang. Dept.
Seneca Junior High School
850 Pachogue-Holbrook Rd.
Holbrook, NY 11741

Hornell, NY

Chairman, F. Lang. Dept.
Hornell High School
Maple City Park
Hornell, NY 14843

Irvington, NY

Keiko Hirano
Hillside Terrace
Irvington, NY 10533

Jamaica, NY

Chairman, F. Lang. Dept.
I.S. 238
8815 182nd Street
Jamaica, NY 11423

Jamestown, NY

Chairman, F. Lang. Dept.
The Jefferson School
195 Martin Road
Jamestown, NY 14701

Kenmore, NY

Chairman, F. Lang. Dept.
Herbert Hoover Middle School
294 Thorncliff Road
Kenmore, NY 14223

Lackawana, NY

Chairman, F. Lang. Dept.
Lackawana Junior High School
550 Martin Road
Lackawana, NY 14218

Mahopac, NY

Chairman, F. Lang. Dept.
Mahopac Junior High School
Baldwin Place Road
Mahopac, NY 10541

Mohawk, NY

Chairman, F. Lang. Dept.
Mohawk High School
28 Grove Street
Mohawk, NY 13407

New York, NY

Emil J. Lugo
319 East 24th St. #1F
New York, NY 10010

Oneonta, NY

Chairman, F. Lang. Dept.
Oneonta Junior High School
East Street
Oneonta, NY 13820

Parish, NY

Chairman, F. Lang. Dept.
Altmar Parish-Williamstown MS.
Route 22
Parish, NY 13131

Staten Island, NY

Chairman, F. Lang. Dept.
I.S. 24, M.S. Barnes I.S.
224 Cleveland Avenue
Staten Island, NY 10308

Rosemarie Fana
Curtis High School
St. George
Staten Island, NY 10301

Valley Stream, NY

Chairman, F. Lang. Dept.
Valley Stream Memorial J.H.S.
Fletcher Avenue
Valley Stream, NY 11582

West Nyack, NY

Chairman, F. Lang. Dept.
Felix V. Festa J.H.S.-South
Demarest Mill Road
West Nyack, NY 10994

Whitesboro, NY

Chairman, F. Lang. Dept.
Whitesboro J.H. School
Oriskany Boulevard
Whitesboro, NY 13492

WI

Milwaukee, WI

Chairman, F. Lang. Dept.
Riverside University H.S.
1615 E. Locust
Milwaukee, WI 53211

Mr. RITTER. But I think overall we can all say that the number of courses in Japanese and the number of students studying Japanese in our high schools is a very small fraction of the combined total of all other foreign languages I think if you really wanted to do business in Japan, you have to learn more than just technical translations. I mean, I think it is important to do technical translations, but I think we need a cadre of people who've studied Japanese, who've studied Japan, the culture, and that we do this kind of thing and the way we do it with other languages. We just don't have the opportunity right now.

Where would we get these people? Where would these teachers come from? Where would the knowledgeable people to teach courses in Japanese literature, history or whatever—where would all this come from if we tried to do something in the high school, even remotely approaching the foreign language training we have in other areas, which doesn't seem to be nearly as—as great a need at the present time?

Dr. DAUB. Well, why not use public television as a medium in the schools? Why not have TV programs to teach Japanese? You are not——

Mr. RITTER. Actually, in New York City, they do have on public—one of the channels—I think it either a cable channel or a public TV channel—they do have some Japanese.

Dr. DAUB. That is what we have got to do because you are not going to train that number of teachers, nor are you going to have that many in any given high school who want to take it. We tried on the Wisconsin Public Radio Network to teach Japanese and we had scattered students taking it using an NHK radio conversation course.

Mr. RITTER. I'd be leery about trying to learn a new language like Japanese on a public radio network. I mean, I think that'd be an awesome and difficult task.

Let me close—I just—I think we should ponder these questions because I don't believe we've answered them and I am not sitting here with the answers, either, but I think they are wide open questions that this society, I think, has to ponder very carefully and this committee can.

I understand that—and there are some people at the recent conference—at the National Bureau of Standards, who commented on this, that it is difficult for our technical personnel to work in the Japanese laboratories and institutes and that contrary to what representatives of the Japanese Government have been saying. It's a tough hole to get in and to work there.

Could anyone here comment on that?

Ms. HUBBARD. I can tell you that the Japanese companies who are paying a large part of the freight for our program are falling over themselves to find students. I don't know exactly in what context that perhaps was stated, but we have to be careful, in fact, that we don't send our good people over there and they stay. We want them to come back.

Mr. RITTER. I understand that these were government laboratories——

Ms. HUBBARD. OK, government laboratories, I can't comment, but the companies want them.

Dr. STRULL. I mentioned in my remarks an exchange program, Westinghouse and Mitsubishi, and we have sent Americans there to work for 1 year with a fairly favorable result. They're given language and culture training before they go over, very extensively, and they work; they are accepted and they come back with a better feeling for Japan. I've cited this is my prepared statement.

Mr. RITTER. Professor Daub, do you have a comment on that?

Dr. DAUB. No; but I know that there have been exchanges when faculty members at a university have had a visiting scholar from Japan, they often go and return, but not necessarily to government laboratories or industries, but universities.

Mr. RITTER. Uh-huh. I think that this in general would be, I think, wise policy for the Japanese Government, as well as industry, to follow in having some of those doors open because after all, Japanese have had open doors in this country for decades and I think that's the balance of my questions.

Thank you, Mr. Chairman.

Mr. WALGREN. Thank you, Mr. Ritter.

Well, on behalf of the subcommittee, I would certainly like to express my appreciation to the witnesses for their efforts in developing their presentations and for being a resource to the committee. I think we developed a new area of comment in these hearings. Although it was a little bit different from the direction we thought the hearings would take, nevertheless I think it was more than helpful and constructive from our point of view, and we certainly appreciate your roles in it.

Thank you very much.

[Whereupon, at 3:45 p.m., the subcommittee was adjourned, to reconvene subject to the call of the Chair.]

THE ROLE OF TECHNICAL INFORMATION IN U.S. COMPETITIVENESS WITH JAPAN

THURSDAY, JUNE 27, 1985

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
SUBCOMMITTEE ON SCIENCE RESEARCH AND TECHNOLOGY,
Washington, DC.

The subcommittee met, pursuant to call, at 10 a.m., in room 2325, Rayburn House Office Building, Hon. Doug Walgren (chairman of the subcommittee) presiding.

Mr. WALGREN. Well, let me welcome you all to the second day of this subcommittee's hearings on the role of technical information in United States competitiveness with Japan.

Yesterday we heard the views of a variety of private sector witnesses on the lack of awareness in this country regarding how our major competitor, Japan, thinks and acts; on the possibilities of Americans learning and becoming familiar with the Japanese language, and also on the state-of-the-art of our translation efforts, including those that are machine-based.

Today, after hearing from Mr. Caplan, from General Motors Research Laboratory, we will hear testimony from several of the Government agencies that are the most involved and have the most contact with the Japanese scientific and technical information area.

The witnesses have been asked to address the comparative technical strengths of the United States and Japan and the role of the Federal Government in developing the capability we must have to be effective in interacting with such a major trading partner and in meeting the very real economical challenge that Japan presents to the United States as an economic competitor.

We appreciate the effort that the witnesses make to come to Washington and make these presentations. Let me say at the outset that written statements will be included in the record in the fullest detail.

Let me ask the witnesses to be somewhat conscious of time, although we have time for you in presenting your oral testimony. I hope that you would try to outline the points that you feel really deserve to be underscored and make them in whatever way you feel is most effective.

There will be two parts to the record: one, the written testimony presented in full, and then the verbatim testimony that we develop here. We hope that we can have a little time for discussion with you.

Our first witness today, John Caplan, is the executive director of the General Motors Research Laboratories. We appreciate very much your coming again, Mr. Caplan, and we are looking forward to your testimony.

STATEMENT OF JOHN D. CAPLAN, EXECUTIVE DIRECTOR, GENERAL MOTORS RESEARCH LABORATORIES

Mr. CAPLAN. Mr. Chairman, good morning. I am pleased to have an opportunity to present GM's views on the role of technical information in United States competitiveness with Japan.

It should not surprise anyone that GM is very interested in scientific and technological developments in Japan. Some of our strongest competitors, both worldwide and in the United States, are based in Japan. To compete successfully, we must be aware of advances in product and process technologies around the world. GM has made concerted efforts to ensure that our reseachers have access to or are at least aware of research performed in their field in Japan.

On March 7, 1984, Robert W. Gibson, head of GM Research Laboratories Library, presented to this subcommittee our views on the availability of Japanese scientific and technical information in the United States.

Some of you may recall that GM began an extensive study in 1977 on this subject. We published a hard-cover book of our findings in 1981. I have a copy with me. It is called "Japanese Scientific and Technical Literature," by Gibson and Kunkel, and was published by the Greenwood Press in 1981.

We also mentioned in our 1984 testimony that the National Technical Information-Service's, Japanese high technology information agreement had resulted in only a trickle of Japanese reports to the United States.

In 1983, only 170 technical reports were generated from Japan, as compared to over 20,000 originating in the United States. The situation has improved only slightly. Recent information indicates that 601 reports were obtained from Japan in 1984, and so far, some 33 reports have been recorded in 1985.

Our 1984 testimony also detailed proposed efforts of other organizations to improve the availability of Japanese literature, literature abstracts and indices. Unfortunately, none of those proposals has as yet been implemented.

The one bright spot is that in September 1985, University Microfilms will begin providing abstracts of some 400 to 700 Japanese journals not covered elsewhere.

Today I would like to emphasize that the flow of technical and scientific literature out of Japan has not improved to any great extent. Our Government could play a more positive role in supporting private information-gathering activities, and in ensuring that so-called technical reports from the Japanese Government Laboratories are made available.

As you know, the automobile business is international in character and GM operates on a worldwide basis. Thus we have both the incentive and the opportunity to collect and assess technical information from around the globe.

For Japan, our technical data collection activities are headquartered in our GM Overseas Development Corporation-Japan. We maintain technical representation in this office to keep abreast of current Japanese developments and activities that are often not reported in technical publications.

Equally important, we have a continuous stream of scientific and technical experts from GM attending symposia and other meetings in Japan. Better availability of Japanese literature can be an important supplement to these sources of information.

We also have a steady stream of technical visitors from Japan. Those from universities and noncompeting commercial companies offer a wealth of information on Japanese technological developments and plans which do not often appear in the literature.

As you are no doubt aware, all the major Japanese companies maintain a cadre of technical people in the United States to gather information. Sometimes we think that they know more about GM's business than we do. Obviously, they have found this activity invaluable, and it also serves as a management development tool for their personnel.

What is the technical strength today of Japan vis-a-vis the United States? Let me restrict my response to science and technology in the automotive sector. Japan has played a most successful catch-up game since the mid-1960's, and today they are first-rate in automotive technology. In fact, the competition for technological leadership is keen among Europe, Japan and the United States.

On the other hand, Japan is still playing catch-up in more basic technical efforts which eventually form the basis for technology. By technology I mean the successful commercial implementation and application of technical and scientific developments. However, Japan has excelled in the rapid introduction of technology developed both in Japan and in other countries.

Much of the credit for the Japanese success in commercial application of new technologies goes to Japanese strengths in management. It has been my observation that in spite of the so-called consensus system in Japan, management is much more autocratic than in the United States. In addition, lines of decision and delegation seem to be clearer, enabling Japanese firms to act quickly to exploit new opportunities.

I also do not want to leave you with the impression that our lead in the more basic technical efforts is secure. An increasing share of Japanese research and development expenditure, both public and private, has been devoted to basic research in recent years. Thus, Japan may become much more formidable in new technical fields affecting both product design and manufacturing processes. For that reason, we must, as a nation, continue to improve our capability to monitor and understand the Japanese technical scene.

Mr. Chairman, that concludes my prepared remarks. I will be pleased to respond to any questions the subcommittee may have.

[The prepared statement and biographical sketch of Mr. Caplan follow:]

PREPARED STATEMENT OF JOHN D. CAPLAN

I am John D. Caplan, Executive Director of GM's Research Laboratories. I am pleased to have an opportunity to present GM's views on the Role of Technical Information in U.S. Competitiveness with Japan.

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Mr. Chairman, that concludes my prepared remarks. I will be pleased to respond to any questions the Subcommittee may have.

JOHN D. CAPLAN

Curriculum Vitae

John D. Caplan is Executive Director of the General Motors Research Laboratories. He was appointed to this position in 1969, and has general responsibility for the Operations, Policies, and Technical Programs for the Research Laboratories.

Mr. Caplan was born March 5, 1926 in Weiser, Idaho. During World War II he attended Stanford University under the Army Specialized Training Reserve Program and later served in Australia, New Guinea and the Philippines. He was graduated from Oregon State University with a bachelor of science degree in chemical engineering in 1949. In 1955, he received a master of science degree in mechanical engineering at Wayne State University. Mr. Caplan completed the Advanced Management Program at the Harvard Graduate School of Business Administration in 1976.

Mr. Caplan joined the GM Research Laboratories in 1949. He was named Assistant Department Head of the Fuels and Lubricants Department in 1955 and Department Head in 1963. In 1967, Mr. Caplan was appointed Technical Director of Basic and Applied Sciences for the Laboratories, and served in this position until he received his current assignment.

In 1964, Mr. Caplan received the Crompton-Lanchester Medal of the Institution of Mechanical Engineers--Britain's premier automotive engineering award. He was elected to the National Academy of Engineering in 1973.

Mr. Caplan has served as President and a Member of the Board of Directors of the Coordinating Research Council, and as Chairman of the Section on Industrial Science of the American Association for the Advancement of Science. He also has served as Chairman of the Directors of Industrial Research.

Mr. Caplan is a Fellow of the American Institute of Chemical Engineers and the American Association for the Advancement of Science. In addition, Mr. Caplan is a member of the American Chemical Society, American Management Association, Combustion Institute, and the Society of Automotive Engineers.

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Mr. WALGREN. Thank you, Mr. Caplan. You mentioned this interchange of people, their visiting us and you making a concerted effort to visit their operations and join in their symposia.

Have your people felt the need to have greater language capabilities, people that the General Motors would send to Japan and to visit some of those symposia? Do they generally have capability in the Japanese language at that point?

Mr. CAPLAN. No; they do not. Fortunately, English has more or less become the international language of science, so the symposia generally are in English. However, we find it necessary for our technical representation, normally in Tokyo on a permanent basis, to have a command of the Japanese language, obviously, with reading and speaking.

Mr. WALGREN. How do they get that capability?

Mr. CAPLAN. Some of them are United States native-born people who have acquired that skill; they are of Japanese ancestry. Some of them were originally Japanese nationals. We have several former Japanese nationals working in our laboratories.

Mr. WALGREN. Do you have a laboratory in Japan?

Mr. CAPLAN. No, we do not.

Mr. WALGREN. How big an effort is it in Japan and in general terms?

Mr. CAPLAN. Well, we have the permanent office there for Japan, which covers not only the technical areas but also obviously commercial areas and the like. I am not sure what the total size of it is but it is an effort really to have a Japanese speaking and reading source to obtain much of the information about technological developments, which of course, may never appear in the formal technical literature or may be in the form of activities sponsored by MITI and the like, which again do not see the normal open literature.

Mr. WALGREN. How many people do you have in that capacity, just on the technical side there? Is it a big or small operation?

Mr. CAPLAN. It is a small operation. It is, I think, a two-man operation at the moment. But, again, they serve as the channel, the funnel to pick up information, which then comes back to the United States where its assessment and the like is carried out.

Mr. WALGREN. I see. But that certainly is strikingly small.

Mr. CAPLAN. We find, of course, in most specific technical fields that agencies, a technical generalist serves a good purpose, but if you want to be aware of what is going on in a certain technical field you have to have the technical experts visit Japan and meet with the people there. You can't depend on this liaison-type activity.

Mr. WALGREN. Are you pretty satisfied in your industries that Japan is working in English to the degree that you would want to have access to? You say that your people couldn't speak Japanese but yet they go to symposia because the symposia are generally conducted in English as an international scientific language. They can participate easily in that. Are there levels of discussion in Japanese meetings that you would like to attend but don't because you don't have the language capability?

Mr. CAPLAN. Not so much meetings, but one of the findings of our study is, of course, much of the Japanese literature is never translated into English. It is never indexed into English. In fact, it

is never indexed. So there is a great deal of work going on in Japan that is published in Japanese journals which is very difficult to become aware of. That was one of our findings, that we need better indices of at least what those publications are, and English versions. Not complete translations, but at least translations of the abstracts.

Mr. WALGREN. I am really struck by the fact that so little is flowing out of this effort by the Japanese to translate into English. You say that there is an agency over there that is asserting that it has responsibility to translate and make available in English scientific literature, but you indicate that they are coming along at a pathetic rate in terms of numbers.

Mr. CAPLAN. The flow seems very, very small to us. For instance, I think it was last year on a similar basis of information that was submitted from the United States. Something like 33,000 publications documents went into the system as opposed to a few hundred from Japan. So where they are active technically and scientifically, so obviously, we are not getting the full benefit.

Mr. WALGREN. This question would probably be addressed better to someone else. Are you aware of any efforts of our Government to try to object or push them to make a greater effort in this translation area? Has our Departments of State or Commerce focused on the fact that they are only translating 33 reports this year and that's all?

Mr. CAPLAN. I am not sure within the last year what additional activity may have been made by any of these agencies. Part of the difficulty may be getting agreement as to the nature of what will be translated. For much of the work that is going on in Government laboratories in Japan, the publications do not go into the open literature like they do in this country.

In other words, anything that essentially is done of a non-security nature in this country is published from work in Federal laboratories.

Mr. WALGREN. Does General Motors have any specific language training programs for your people that might be involved with Japanese regulations? Have you built into your employee training system some courses that would familiarize people with Japanese? Yesterday we heard testimony that there are now beginning to be some short term scientifically focused language training programs offered that would seem to be within the reach of American businessmen, seven week courses.

Mr. CAPLAN. Obviously, when we are going to send somebody to a Japanese speaking area for a fixed assignment, we greatly encourage them to acquire some modicum of language skills from a conversational standpoint. Even our visitors, before they go to Japan, are expected to acquire enough words so that they can handle themselves in a polite manner, which is very important.

However, language skills which one can pick up rather rapidly do not help a bit on the translation and the reading, which is, of course, a very formidable situation with their multiple alphabets and the like.

Mr. WALGREN. This study that General Motors produced there, what is the range of that study? What were its major focuses and conclusions?

Mr. CAPLAN. What we have gone through is a whole range of subjects. I am here in Natural Sciences, geography. What we have is a listing and analysis of the tremendous number of publications that occur in Japan. Which ones of them are translated into English, which ones of them are abstracted by Japanese agencies, by U.S. agencies and the like. If you look in the front, we have done a complete analysis with respect to, for instance, even the agricultural sciences, which is not directly related to General Motors. If you look at those indexed by western sources, 35 percent of those still remain in Japanese. The remainder are in western languages. This varies greatly by various areas.

For instance, in the same field, if you look at those that are not indexed by western sources, meaning that they are not normally available to us, then you get up to as high as 86 percent of those. Of course, the texts are in Japanese, and we don't have the capability apparently to index them. So this is what it is, an analysis by field.

We got into this because the question was asked. How do you know what is going on in Japanese technology? This is a very legitimate question. The analysis indicated we do not have a very good pipeline into that.

Mr. WALGREN. When your people in Tokyo develop a translation, or pinpoint a piece of literature that they think is important, is that generally shared beyond General Motors at that point, or is that something——

Mr. CAPLAN. No, that is proprietary.

Mr. WALGREN. So other kinds of circles in this country would not necessarily become aware of that?

Mr. CAPLAN. Not necessarily. However, through our normal sources, for instance, if we happen to have accumulated, a particular series of Japanese literature which is translated, we make that available to other people through the special libraries of the association, yes.

Mr. WALGREN. The Chair would recognize Mr. Henry.

Mr. HENRY. Thank you, Mr. Chairman.

Mr. Caplan, in the tremendous gap of transmission of information from West to East versus East to West, is this primarily just the language barrier in your viewpoint, or does it go above and beyond?

If it is a language barrier, I can hardly get upset with the Japanese. It is a result of our culturalization and our inability to face that problem, whether it be at the corporate or educational level. You can't blame the Japanese if they don't want to translate everything into English. Is that the blockage?

Mr. CAPLAN. No. As I mentioned, I think there is a great deal of effort in Japan and sponsored by the Japanese Government that does not become available in the open literature whether it is in Japanese or English.

Mr. HENRY. Let me pursue a little bit more carefully at that level then. Is it because the applied research in Japan tends to be in their system more heavily involved in integration between their corporate structure and government research and inherent in that process? Would that not be true in this country if we used much more of that kind of research mold? Is it, first of all, characteristic

of that kind of Governmental business investment management alliance, or is it above and beyond that?

Mr. CAPLAN. It may be very well as you point out, that particular alliance. As you know, in this country if the private sector engages in some research utilizing Government funds, totally or in part, results of that research must go into the public record. That is not obviously the practice in Japan.

Mr. HENRY. Is that law in Japan or just not the practice?

Mr. CAPLAN. I really don't know the reasons for it.

Mr. HENRY. But the public law as it stands, that is correct, when we have this co-mingling of funds, the research results are non-proprietary and are published unless national security is in there. As a matter of public policy, we deliberately review——

Mr. CAPLAN. And not only is it available to citizens of the United States but citizens throughout the world.

Mr. HENRY. You are unable to tell me whether the Japanese have a law which prohibits——

Mr. CAPLAN. Yes. I am not familiar with the legal——

Mr. HENRY. The other difference would likely be—in the United States, for example, if you are involved in research even in the private sector, university-affiliated, your access to recognition, to promotion, to honor and to attributed virtue is published, and you publish or perish your results in the academic sector and increasingly to a certain extent to the private sector. Because of the co-mingling of these things, we just don't have this proliferation of professional journals in Japan?

Mr. CAPLAN. They have very many journals. They are prolific publishers of journals.

Mr. HENRY. I understood you to say there wasn't that kind of dissemination in Japanese circles as there is in the United States in terms of university publications.

Mr. CAPLAN. The university people in Japan publish and the private sector people do publish and much of that is available. A lot of it, though, is published in Japanese and is not picked up by any of the indexing organizations, so there is no systemmatic way of getting that. The Japanese do not even have an indexing system for themselves——

Mr. HENRY. They have no indexing system for themselves.

Mr. CAPLAN. They have a plan they have been working on for some time but it doesn't cover all the publications.

Mr. HENRY. Which would be a hindrance to their own technological advance. So it is a failure in their own society, which is disadvantageous to us.

Mr. CAPLAN. And I think they recognize that and are trying to change it. But at the moment there is still a lot of the literature that becomes transparent to us.

Mr. HENRY. You really are relatively ambiguous as to what extent this is a deliberate attempt to withhold technology transfer?

Mr. CAPLAN. Oh, yes. I don't know what the motives are, and I prefer not to address them.

Mr. HENRY. Would it be fair to the vast majority of the imbalance we perceive, the strong preponderance, the balance we perceive in technology transfer across the ocean is primarily a func-

tion of our foreign language weakness more than anything else? Would that be the dominant problem?

Mr. CAPLAN. I don't believe so.

Mr. HENRY. What would be?

Mr. CAPLAN. I would like to distinguish between normal university publications which are in the normal literature and those that result from programs sponsored by the Japanese Government.

I think there is a distinct difference between the processes and procedures and ways of operating in Japan and the United States. If I wish, as a visitor from Japan, to visit the National Bureau of Standards, I am sure I would be welcomed with open arms, and if I was interested in a particular subject area I would be shown That activity. When I go to Japan and wish to visit the MITI laboratories, life becomes a little more difficult.

Mr. HENRY. So the primary issue is not the language.

Mr. CAPLAN. Right.

Mr. HENRY. And it is the Government-sponsored research or integrated research which in Japan is stronger than in your own sector.

Mr. CAPLAN. Yes.

Mr. HENRY. Thank you.

Mr. WALGREN. If I could just pursue that. In your view, since English has become the language of science, even in Japan, it would seem that the Government laboratories at least would be developing their work in English at that point. Do you know whether it is?

Mr. CAPLAN. I will say that their Government laboratories from time to time will publish summary descriptions of their activities. But for the individual project reports, I am not sure what language they are prepared in.

Mr. WALGREN. Well, I don't know whether it is up to us to——

Mr. CAPLAN. I think you could probably find some other source of expertise on that than myself.

Mr. WALGREN. But certainly that is a ready resource. It is a little impervious of somebody over here to say they ought to do this or ought to do that. At the same time it is striking that since they do have substantial English capability in the sciences, what is being published is very little since a large part of their scientific effort is driven through Government entities, and it is the Government that is the acting agent, you would question the breadth of the English availability in that area.

Mr. CAPLAN. Particularly in the areas leading to advanced technologies.

Mr. WALGREN. The Chair recognizes Mr. Valentine.

Mr. VALENTINE. Thank you, Mr. Chairman.

Mr. Caplan, there is at North Carolina State University a department which is called, I believe, the United States-Japan Institute or something of that kind, which is involved in an effort to bridge the gap in culture between the United States and Japan.

It is my understanding that they arrange for students to spend long periods of time in Japan in an attempt to become familiar with the language, not just from text books but to learn how to function with the language of the Japanese and to learn more about the culture and their habits and so on. Are you familiar with

that Institute or others that are located in colleges and universities in this country?

Mr. CAPLAN. Yes.

Mr. VALENTINE. Are you able to make an assessment as to the contribution that they have made as of now? And maybe the potential to address the problem we are talking about here?

Mr. CAPLAN. Obviously, I think they serve a real need, and we obviously need to have more people in this country who have had such training and education. I don't believe they address the particular problem that we are dealing with in the scientific and technical areas as such. For the more generalists, they serve the purpose, but I don't think they are addressing this specific problem, nor necessarily should they within their charter.

Mr. VALENTINE. Do you think that it is necessary from your vantage point to accomplish what you are interested in with regard to our getting fuller and more complete information about advances in Japanese technology? Do you think that these institutions or those departments, say, the one at North Carolina State, I think there is one at Harvard, and I am sure there are some on the west coast—could be changed or should be changed to address the problem you see?

Mr. CAPLAN. Yes. If we wish to do more as a nation to formalize our approaches to acquiring what is going on in the Japanese literature, that could be very well done through private institutions.

Mr. VALENTINE. Thank you, Mr. Chairman.

Mr. WALGREN. One other open-ended question. You indicate you would like to see our Government playing a more positive role in supporting private information-gathering activities and focusing on the products of the Japanese Government laboratories. Can you give us any more direction in what you would like to see our Government doing in this area?

Mr. CAPLAN. I am hesitant. I don't like to prescribe to the Japanese Government how they should behave. I think I will leave that to the wisdom of you and your colleagues, as to how that might be approached. There is also a matter of leadership; then there is a matter of finance.

Mr. WALGREN. Would it be fair to say you would like to see our efforts in the Department of Commerce and the National Technical Information Service and some of the library supports and things like that in this area emphasized and directed to try to do more in that way?

Mr. CAPLAN. Yes.

Mr. WALGREN. Well, thank you very much.

Mr. HENRY. Mr. Chairman, one question if I might.

General Motors used to run one of the major technical engineering schools in Michigan. That has changed a little bit, but basically the relationship is very, very close.

Mr. CAPLAN. Actually, it has become now an institution where any firm essentially can sponsor students, and their strength has been in the——

Mr. HENRY. Do you have any Japanese professors or instructors at the institute?

Mr. CAPLAN. I do not believe so.

Mr. HENRY. Is there any Japanese language component in the institute?

Mr. CAPLAN. I guess I am not close enough to answer that definitively, but I suspect not.

Mr. HENRY. Do you have any fellowship program where you send your people to Japan and Scandinavia or elsewhere to learn what is happening in other fields in metallurgy, technical application?

Mr. CAPLAN. Yes.

Mr. HENRY. Your students do go?

Mr. CAPLAN. I am sorry, not our students. Once they come to our laboratories we will send our people out on sabbaticals and the like to various places. For instance, in Japan, there is the Riken Institute. We have had coworkers back and forth. This is an institute concerned with the deformation of metal and the like, which is of particular interest to us, so we do this, but I don't believe the former General Motors Institute does that.

Mr. HENRY. Are there language requirements in the Scandinavian or Japanese requirements for those students?

Mr. CAPLAN. If they are going to a country like that——

Mr. HENRY. Not if they are going to a country like that. Just are there language requirements for them?

Mr. CAPLAN. I am not sure I understand your question.

Mr. HENRY. I am not necessarily asking whether they are going anywhere. Do they have to become proficient in a second research language?

Mr. CAPLAN. No. That is an undergraduate institution, and generally your language requirements as far as——

Mr. HENRY. They might have 2-year minimal exposure to French, Japanese, or the like?

Mr. CAPLAN. Right.

Mr. HENRY. Thank you.

Mr. WALGREN. Thank you, Mr. Henry.

Thank you, Mr. Caplan. We appreciate your being available to the committee.

The second group I would like to call together. Dr. Joseph Caponio, Director of the National Technical Information Service; Charles Horner, Acting Assistant Secretary for Oceans and International Environment and Scientific Affairs; George Mu, Office of Japan, International Trade Administration; and Dr. Ernest Ambler, Director, National Bureau of Standards, Department of Commerce.

If you gentlemen could come forward. We appreciate your coming, and look forward to your testimony.

Why don't we proceed in the order in which I called you, for lack of any other structure. So, Dr. Caponio, if you could lead off.

STATEMENTS OF DR. JOSEPH F. CAPONIO, DIRECTOR, NATIONAL TECHNICAL INFORMATION SERVICE; CHARLES HORNER, DEPUTY ASSISTANT SECRETARY FOR SCIENCES AND TECHNOLOGY; GEORGE MU, OFFICE OF JAPAN, INERNATIONAL TRADE ADMINISTRATION; AND DR. ERNEST AMBLER, DIRECTOR, NATIONAL BUREAU OF STANDARDS, DEPARTMENT OF COMMERCE

Dr. CAPONIO. Thank you. I appreciate the opportunity to testify before this committee once again on the subject of U.S. access to Japanese technical information. I have submitted a prepared statement for the record, and I will, of course, be happy to respond to questions about our activities in this area.

Congress granted NTIS funds during fiscal years 1981 through 1983 to actively collect, translate and disseminate foreign technical report literature of potential interest to U.S. industries. Industry itself regarded this activity of such importance that we decided after funding was terminated to retain as much of the program as it was possible to do so on a self-supporting basis.

Most importantly, the acquisition mechanism that we had established in Japan was left intact. This mechanism includes, first, the services of an acquisition representative in Japan. This person is a Japanese national, a former national officer and bank executive with the ability to work effectively with the Japanese system; second, the services of the prestigious Mitsubishi Research Institute, the first think tank of Japan; and, third, close coordination with the staff of the U.S. Embassy in Tokyo.

I should mention here our acquisition effort is aimed primarily at the technical report literature. This kind of literature is generally never intended for distribution beyond a limited circle of readers. Although it may be unclassified, it is often not available to the public even in its country of origin.

Furthermore, all technical reports in Japan are considered to be copyrighted. NTIS must therefore negotiate with the Japanese sources of this information for release of the documents to NTIS and for the permission to reproduce and disseminate there. NTIS has been quite successful in negotiating with Japanese sources. We have, in fact, 18 acquisition agreements in place with Japanese organizations.

These include agreements which provide a close working relationship with the Japanese Information Center of Science and Technology, and an agreement which provides access to technical reports produced by the laboratories of the agency of Industrial Science and Technology, which is MITI's research arm.

Various figures have been given in the past concerning the amount of scientific and technical information published in English in Japan. The figure most commonly heard is 20 percent. This may be true for the openly published literature, but it certainly does not apply to the technical report literature. Almost none of the latter appears in English.

Thus, we are in the rather frustrating position of having to access a large body of Japanese technical literature which we cannot use because of the language barrier.

I think that the committee is well aware of the high cost of translating material from Japanese into English. A recent survey has shown the average going rate in the Washington area for a technical document is $70 per English page translated. NTIS simply cannot recover the cost of translating the highly specialized documents that it deals with.

Thus, most of the Japanese technical reports that we have access to remain in Japanese. We are currently attempting to partially surmount the problem through cooperative arrangements with organizations who may be willing to undertake some of the translation work in return for some targeted acquisition work on the part of NTIS. We are hopeful that at least some of these arrangements will eventually alleviate the problem.

NTIS has had over 5 years' experience in gaining access to Japanese technical literature and has a proven mechanism in place to do so.

As a Government agency, NTIS can negotiate directly with the Japanese Government entities and also enjoy certain advantages in negotiating with non-Government organizations. Furthermore, it has 40 years' experience in reproducing, promoting and disseminating technical-report literature. NTIS is actively contributing to the body of Japanese technical literature available in the United States.

I feel confident that through cooperative programs and other means, we will eventually bring the mechanism we have constructed to its full potential.

Mr. Chairman, I would be pleased to answer any questions pertaining to the statement.

Thank you.

[The prepared statement and biographical sketch of Dr. Caponio follow:]

Prepared Statement of Joseph F. Caponio

THE ROLE OF JAPANESE TECHNICAL INFORMATION IN U.S. COMPETITIVENESS: THE CONTRIBUTION OF NTIS

Mr. Chairman, I appreciate the opportunity to appear before this committee again, to describe NTIS efforts to provide Japanese technical information to business and industry. Last year, we described the history of the NTIS program to acquire foreign technology and especially our experience in processing Japanese technical information for use by American industry. The four thrusts of this program are:

1. To identify foreign technical information needed by U.S. industry. Two surveys to identify these needs were conducted when the program started in 1981.

2. To acquire foreign technical documents of interest to U.S. industry. This is done by direct contact with foreign sources, contracted acquisition specialists, and a joint effort with NTIS Cooperating Organizations in the country of origin.

3. To translate some of the documents acquired. We have arranged for translations using the Joint Publications Research

Service (so long as they were available), private contractors or NTIS Cooperating Organizations.

4. To disseminate this information to U.S. industry. We announce the information through standard NTIS media, a new periodical announcement journal (Foreign Technology Abstract Newsletter) and special promotions.

The Foreign Technology Acquisitions (FTA) program began with a Congressional appropriation totalling $1.5 million from 1981 through 1983. It has continued with $250,000 annual funding from NTIS general revenues in 1984 and 1985.

I would like to summarize NTIS activities and accomplishments in the past year, with some new insights about the benefits for U.S. business and industry.

IDENTIFICATION OF INDUSTRY NEEDS

NTIS has pursued contacts with the private sector, based on what was learned in the surveys conducted in 1981, augmented by our normal network of professional contacts. We have found, as have others, that, after our surveys were conducted there was a major increase in the awareness that 1) the U.S. was no longer miles ahead of the rest of the world including Japan, and 2) Japan

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possessed techniques and technologies which we should be able to utilize.

We have noted with interest the study published by G.S. Hane at the Pacific Northwest Laboratories last September based on interviews with 101 researchers to rate the quality and availability of Japanese applied research. These factors were rated strong or very strong in eight out of ten rapidly advancing fields of technology.

We have recently begun our own systematic check to see how industry needs for Japanese scientific and technical information are changing. All respondents thus far have expressed interest in broadening their access to this kind of information, particularly reports which are to be found outside their current reach. Our progress in meeting these needs will be apparent to you as I describe our acquisition efforts.

ACQUISITIONS EFFORTS

Regarding our direct acquisitions, NTIS now has formal agreements with 75 foreign source clients, 17 of which are in Japan. In addition to report literature acquired through our own initiative, NTIS receives a great deal of foreign input by virtue of bi-lateral agreements between other nations and DoE, NASA, DoD and other agencies; this documentation is passed along to NTIS

for access by U.S. industry. As a result, some 24% of our 1984 input was from foreign sources.

We have worked to fill in the gaps in available Japanese information. It has been important in doing this to approach the Japanese, with the indispensable aid of our Embassy in Tokyo, in our capacity as an agency of the United States Government.

Of our 17 Japanese agreements, two were new in 1984, and there have been two more in 1985. One of the agreements signed in 1984 is with the Agency of Industrial Science and Technology (AIST), which embraces sixteen government laboratories in high priority fields, such as metrology, mechanical engineering, industrial chemistry, fermentation, polymers and textiles, geology, electrotechnology, and pollution control. Two other extant agreements were amended to include additional research centers.

Our document input from Japan was some 400 reports in 1983, and that number increased to more than 500 in 1984. A typical calendar of events is seen in our dealings with AIST: our agreement was signed in April 1984; the first documents were received in October 1984, since which date we have received 48 documents. Most of the material we are sent is high-gloss and carefully edited, corporate, technical journals. A similar grade of documentation has been received from Asahi Glass, Fuji Electric, Mitsubishi Heavy Industries, Toshiba, Nippon Kokan and Nippon Steel. NTIS has accepted most documents from Japan that have been offered for input into our collection.

We know that there exists other information that is not commercially published, which is perhaps not as elegant as that which we are being sent now, but perhaps even more valuable. This other information is the same type that NTIS normally collects, to the considerable benefit of American industry. Penetrating this level in Japan is a complicated process which we have just begun to unravel.

The JICST Database

The best example is our recent agreement for access to the database produced by the Japan Information Center for Science and Technology (JICST), under the Science and Technology Agency. JICST is the government organization in Japan most similar to NTIS. Under this new agreement, NTIS has gained permission to perform long distance, online searches of their database. Bi-lingual keyboard operators will conduct searches requested by state-of-the-art research organizations, and the Japanese citation and abstract will have to be translated.

Managers of the JICST database have begun the translation of citations (title, author, and other basic data) into English, and the JICST database should begin to display this in April 1986. Within two years after that, the abstracts should begin appearing in English as well. NTIS has accepted almost anything from Japan

that has been offered for input into the collection, because until now there was no alternative source.

Until the approval of this agreement with JICST, we in the United States have been unable to review the tens of thousands of technical reports in the Japanese language which are available to us. Reports from government laboratories have only been collected and indexed by JICST since 1981. We estimate that the availability of the JICST database will by itself mark a great increase in our scope of access. This should also enable us to enlist technical assistance from our customers in scanning and selecting important reports for translation and dissemination.

Here we touch on one of the key issues facing this Subcommittee today and facing TMIC each day: what are the criteria for selecting information for use by engineers or even inclusion in our collection? When dealing in American technical information we usually have intuitive assurance about the relevance of the report, and as importantly, the cost of scanning the content is quite low.

Some of the questions we must ask are:

- Is it innovative and original?
- Is it a scientific breakthrough, or is it an adaptation of a widely known American innovation?
- Does it offer any technical novelty?
- Does it have commercial significance today, or is it in some ways obsolete?

o Is it practical, useful, applied research?

From the standpoint of the end user, the cost of the Japanese language report from NTIS is the least consideration. The cost of translating the content in order for its usefulness to be considered by an English-reading scientist can be one hundred times greater than the cost of the document. This need introduces the third component of the Foreign Technology Program, sponsorship of translations.

TRANSLATIONS

Most NTIS reports of Japanese origin have an English abstract, and they sell an average of twelve copies even though they are untranslated. Last year we presented some of the difficulties we have encountered commissioning translations of Japanese technical literature. We keep in mind, however, that it takes only one instance of a good match to mushroom a $20 document into a major technical innovation.

Under those kinds of pressures, NTIS has begun to explore the potential of computer-aided translation. This technology, while full of promise, still appears to be at a very early stage in its development. Although the percentage of accurate translation by computer seems to have passed the 60% mark, which may indeed suffice for some "scanning" purposes, it appears that we are

several years away from Sevicon which will provide adequate advancement in the field of full-text translation without extensive technical editing.

We staff has seen demonstrations of the Weidner/Bravice and Fujitsu/Mu-3 I and II systems of machine-aided translation. Short sentence can be translated in seconds, while a more complex thought could take more than a minute. Pre-editing and post-editing can improve the quality and speed of the translation. We understand that Fujitsu is ready to begin marketing their system in Japan as soon as this summer; however, they expressed an intention to make their first overseas market in Europe, not the U.S. The Weidner/Bravice system, which translates only Japanese to English, has also been introduced in Japan, and is ready to be introduced in the U.S. within the next three months. The success of this product will depend on the availability for sale and maintenance of hardware with Japanese language capabilities.

The Japanese appear to be taking the broadest initiative in developing computer-aided translation. Through our official relationships in Japan, NTIS hopes to devise a cooperative project for testing and facilitating the introduction of computer-aided translation in the processing of abstracts, indexes and full text of technical documents. We are also in active discussion with private entrepreneurs in this country about collaboration in translating Japanese technical

information, including possible field testing of those developments. We have found a positive response.

DISSEMINATION TO INDUSTRY

The final and most vital part of our program is dissemination of the information acquired abroad to U.S. industry. This is one of the areas where NTIS was already very highly developed and where there was considerable infrastructure which could be tapped to disseminate the new information efficiently and effectively.

Prior to 1984 NTIS had devised special indexing terms to facilitate identification of technical reports of foreign origin. We announced newly acquired reports in eight permanent announcement media (the Bibliographic Data Base, Government Reports Announcements and Index, Abstract Newsletters, Title Index on Microfiche, Annual Index, Quarterly Digest, NewsLine, and Published Searches) and we created a new newsletter, mentioned earlier, to spotlight foreign technical report literature. In 1984 we issued six special Trade Announcements of Japanese reports offered through NTIS, and we issued some special promotional brochures.

The record of sales of translated Japanese material has been mixed. Of the 530 reports input into the collection in 1984, there were average sales of more than 13 copies per document,

compared to an average of nine copies per document overall at NTIS. Fifteen percent of our Japanese input sells no copies at all, while another 75% sells fewer than six copies.

We provided budget for translating only two reports. One was "Outline of a Study on the Relationship Between Technical Innovation and Labor" with a total of 46,000 words; it cost $3186 to translate, sold only 72 copies, and yielded less than $1300 in sales. On the other hand, a report entitled "Research on the Application of and Material Resources for Fine Ceramics," with 55,000 words which cost $4024 to translate, sold just over 200 copies, yielding just under $4000 income.

CONCLUSIONS

Our enabling legislation mandates NTIS "to search for, collect, classify, coordinate, integrate, record, and catalog [scientific, technical and engineering] information from whatever sources, foreign and domestic, that may be available..." and then to "make such information available to industry and business...and to the general public...."

Under the initiative of our foreign acquisitions program, NTIS has made a concerted effort to collect important documents from abroad for the first time since the end of World War II. As a part of our domestic technology transfer effort, NTIS continues

to interview industry and research and development users of technical reports to guide our acquisitions strategy.

The Administration believes that NTIS has demonstrated a vital role for the Department of Commerce in this arena:

- NTIS has used the uniquely unbiased standpoint of the Government to identify industry needs and respond to them appropriately,

- NTIS has used its official capacity to step into unexplored and undeveloped relationships and establish linkages which will serve the whole nation from now on.

- NTIS has underway a fledgling effort to provide business and industry with important information, in an area where every day lost takes ten to recover.

We continue as the only publicly available source of information without which, the national interest would surely have suffered. It is our responsibility to national policy which makes NTIS an attractive contact point for foreign scientists wishing to cultivate their recognition in the U.S.

I would be pleased to answer any questions you may have about our program. Thank you.

DR. JOSEPH F. CAPONIO

Dr. Caponio was appointed Director of the National Technical Information Service (NTIS) in March 1983, having served as Acting Director since January 1982 and Deputy Director since June 1979.

His information science career includes many top management positions in the Federal Government, i.e., Director of the Environmental Science Information Center of the National Oceanic and Atmospheric Administration, Acting Director of the National Agricultural Library, Scientific and Technical Communication Officer of the National Institutes of Health, Director of Technical Information of the Defense Documentation Center, and Senior Reference Analyst at the Library of Congress.

Dr. Caponio was born in Canton, Massachusetts. He graduated from St. Anselm's College in Manchester, New Hampshire, and earned his Doctorate in Biochemistry at Georgetown University in Washington, D.C. His career as an information scientist spans over 30 years. He has authored numerous papers and has served as an adjunct lecturer at American University and the University of Maryland.

He is a member of the American Chemical Society, the American Society for Information Science, the Epilepsy Foundation of America, and is a Fellow of the American Association for the Advancement of Science.

Mr. WALGREN. Thank you, Dr. Caponio.

Let us turn to Mr. Horner.

Mr. HORNER. Thank you very much.

I, too, am pleased to appear before the subcommittee to offer the views of the Department of State on United States competitiveness with Japan.

Last week we had an opportunity to discuss problems in international scientific relations in general with the science policy task force, and I thought it would be useful to say a word or two about the general state of the science relationship with Japan, at least as it is conducted at the Federal level, and to offer an observation or two as to how this general problem relates to that.

Last April, the United States and Japan signed a 2-year extension of our so-called nonenergy agreement, and at that time we took the opportunity to inform the Japanese Government that we would be undertaking an extensive review of this particular program, that we were going to do it with the encouragement and approval of the White House office of Science and Technology Policy.

The most obvious manifestation of this change is in the marketplace, of course, where Japan has become very competitive in the production of high technology products. This is a complex development and we know that not everyone seems to understand all of the aspects of it.

There seems to be a scientific and technological basis for it, and it is encumbent upon us to take a systematic look at how this relates to the discharge of our own responsibilities.

So in this review we will seek to identify current and projected United States Government studies and research efforts and anticipated efforts in Japan in the fields of science and technology which could be of importance to the United States and try also to assess the degree of coordination and duplication and gaps among the various investigators in order to encourage bilateral cooperation in those fields.

Though we are in the midst of this activity, I think we can share with you today some of our initial findings, which of course, will probably be modified as we go along.

The first and most obvious point is the extremely broad and varied science and technology relationship between ourselves and the Japanese which naturally results in a constant exchange of information.

However, virtually all of the people we have initially spoken with, as well as a cursory review of a number of written reports, indicate that the Japanese have used the exchange to better advantage than we have. There seems to be a variety of reasons for this.

Japan has a very open scientific press and scientific journals abound, but they are, of course, printed in Japanese. The Japanese language poses a barrier for American investigators that is far higher than the English language does for the Japanese.

As we have learned during the seminar held the other day on United States access to Japanese technical literature sponsored by the National Bureau of Standards, that simple formulation of the problem, I think, is well-recognized in this country. Partly because of the differential language barrier and partly because of the difference in how the system rewards different careers, there are

more Japanese scholars in the United States than American scholars in Japan, the Japanese stay longer, pursue more and obtain more advanced United States degrees.

Just to comment at this time, it speaks to a very different concept of the educational system and university system in our two countries. The American university system is the most open in the world. The Japanese system does not have many foreigners affiliated with it. It seems not to have many foreigners teaching, or many foreign students studying, although we think that is changing a bit.

In addition, whereas published information in American scientific journals is immediately available to Japanese who speak English, a wealth of material published in Japan is generally available to American scientists and companies only through the filtering of abstracts or summaries, frequently by nontechnical personnel.

Delays of months or years following the publishing date in Japan are not uncommon and much material is never translated. So this suggests the obvious point of improvements in translation services. If more of our engineers and scientists were proficient in Japanese, especially in reading Japanese, that would be all to the good also.

Though the language barrier is very real, it is only part of the explanation of the fact that the United States has not acquired more of this kind of information from Japan.

The Japanese are much better organized and more determined in gathering information related to science and technology in the United States than Americans are in Japan.

The Japanese closely monitor foreign patents, the Japanese are avid users of the United States National Technical Information Service, they have gained access to United States technology by buying into American companies, and are entering into marketing or production agreements with them. In many instances we could do likewise, but so far we have not, at least not to the extent that the Japanese have.

American organizations have, at least in the past, been remarkably open in allowing Japanese visitors to have access to their laboratories or factories, to see or to photograph or to ask questions and to take notes.

Several persons have commented, however, that United States organizations are increasingly adopting strict policies and giving access to Japanese visitors only on a quid pro quo basis.

The Japanese have taken full advantage of traditional openness of American organizations and continue to pursue this source of information avidly, even in the face of increased restrictions.

It would appear on our initial review that in the area of basic research, Japanese scientists have also generally been very open with their United States counterparts, especially those with whom they have built a relationship over a number of years.

Americans have not taken advantage of this openness to the extent the Japanese have. There are occasions, as science becomes more technology-oriented, when it is more difficult to obtain access to Japanese factory information, particularly to proprietary information.

United States scientists appear to be almost unanimous in their view that relative to the United States, the Japanese either do not

emphasize or do not excel at basic research. There are fields or subfields, such as the investigation of causes of cancer, in which the Japanese are now doing creative original basic research. There are also other fields which they have appeared to make a policy decision to expand their basic research.

However, one of the most common generalizations among American observers is that basic research is still not where Japan's strength lies. We should not be complacent, however; the Japanese have shown themselves adept at doing the necessary to maintain international economic competiveness.

The Japanese appear able to conceive of commercial uses of technology and acquire the necessary basic research results from whatever source to target their R&D activities toward product development and to get a product to market, while United States researchers are still at the basic research level.

Products of the Japanese market may not have been possible without the basic research which had been conducted in the United States or Europe. Japan sometimes benefits from basic research performed in the United States which has nonetheless not yet been applied by American manufacturers. In any case, the result is the Japanese all too often get a new product to market ahead of their competitors.

The preliminary thoughts we have shared with you today will come to be incorporated into the indepth review of how to improve Federal science and technology programs with Japan. We expect to complete this by the end of the summer, perhaps early fall, and the results of our assessment will be the basis of our discussions with the Government of Japan.

Since we are aware that the Japanese have also begun to undertake a similar program at the Government level, the results of both of our efforts will be utilized as we begin our negitiations on the science and technology agreement which will expire in 1987.

And we hope that those discussions provide the occasion for raising points about the exchange of science and technology information, at least at the Government level, where it is appropriate for us to discuss it.

Before closing, I would like to emphasize there is a wealth of open sources of scientific information available in Japan. It is imperative that we improve our methods of collecting it and using it.

I would also like to note since the Japanese are in the vanguard in some of the high technology area, increasing scientific cooperation with Japan will be more and more important to the United States in the years to come.

Thank you very much. I too would be happy to join with my colleagues on this panel in answering questions.

[The prepared statement and biographical sketch of Mr. Horner follow:]

TESTIMONY OF CHARLES HORNER

DEPUTY ASSISTANT SECRETARY OF STATE FOR SCIENCE & TECHNOLOGY

BEFORE THE

SUBCOMMITTEE ON SCIENCE, RESEARCH & TECHNOLOGY

COMMITTEE ON SCIENCE AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

THURSDAY JUNE 27, 1985

I am pleased to appear before the Subcommittee on Science, Research and Technology today, to offer the views of the Department of State on the "Role of Technical Information in U.S. Competitiveness with Japan".

Just last week I presented testimony before Chairman Fuqua on international cooperation in science. I have brought copies of that testimony, in case there may be anyone who wishes to have one. In my remarks I reviewed the role of the Department in the formulation of science policy. I appreciate the opportunity to speak today on one of our specific bilateral S&T programs, that involving the U.S. and Japan.

In my remarks last week, I referred to the White House Office of Science and Technology Policy as setting the overall

science policy for the United States Government. Indeed, in our recent two year extension of the US/Japan Non-Energy Agreement, signed April 28, here in Washington by Assistant Secretary Malone and Japanese Deputy Chief of Mission Mr. Murazumi, we took the opportunity to inform the Japanese Government that we would be undertaking an extensive review of this Non-Energy S&T program, with the encouragement and approval of the White House Office of Science and Technology Policy, with the objective of upgrading certain areas while downgrading or eliminating others. By way of comment Mr. Chairman, I might say at this point that my Division of Science and Technology is undertaking to complete an assessment of all 37 bilateral S&T agreements to determine if we should conduct a review similar to that which we are currently conducting relative to our Japan S&T agreement. We hope to complete that preliminary assessment by the end of this year.

The past twenty years have seen a fundamental change in the relative industrial positions of the United States and Japan. The most obvious manifestations of this change are in the market place, where Japan has become extremely competitive in the production of high technology products. The economic and technological reasons for this development are extremely complex, and the ultimate, definitive analysis has yet to be written. Nonetheless, there is a scientific and technological basis for these developments, and it is incumbent on us in government who deal in the S&T area to take a systematic look at

how these developments relate to the discharge of our responsibilities.

The objectives of our in-depth review are to: 1) identify current and projected US Government studies of research efforts and anticipated developments in Japan in the fields of science and technology of importance to the United States, and 2) to assess the degree of coordination, duplication and gaps among the various investigators in order to encourage bilateral cooperation in those fields.

We are currently conducting that review; however, we can share with you some of our initial findings. I might say at the outset, however, that these are subject to modification as we examine the results in a series of interagency meetings designed to ensure full agreement among the individuals, agencies and departments who have participated in our review.

There is an extremely broad and varied science and technology relationship between the two countries. This naturally results in a constant exchange of information. However, virtually all of the people we have initially interviewed, as well as a cursory review of a number of written reports, indicate that the Japanese have used the exchange to better advantage than we. A variety of reasons have been cited for this inequality. Japan has a very open scientific press,

and scientific journals abound. They are, of course, in the Japanese language.

Obviously, the Japanese language poses a barrier for American investigators far greater than the English language does for the Japanese, who study our language from junior high school through the university. As you have heard during the seminar on "U.S. Access to Japanese Technical Literature: Electronics and Electrical Engineering" sponsored by the National Bureau of Standards (NBS) and the Institute of Electrical and Electronics Engineers, June 24-25 at NBS, the problems are well recognized in this country. Partly because of the differential language barrier, and partly because of the differences in career reward systems, there are many more Japanese scientists and scholars in the U.S. than the reverse, and the Japanese stay longer and pursue (and attain) more advanced U.S. degrees.

In addition, whereas published information in American scientific journals is immediately and readily available to Japanese who speak English, the wealth of material published in Japan is generally available to American scientists and companies only through the filter of abstracts, summaries and translation, frequently by non-technical personnel. Delays of months or years following the publishing date in Japan are not uncommon, and much material is never translated. We should try to improve the translation services and to train many more engineers and scientists in the Japanese language.

The language barrier, and other barriers to U.S. acquisition of Japanese technical information, are very real, but they are only part of the explanation of the fact that the United States has not acquired more information from Japan. The Japanese are much more organized and determined in gathering information related to science and technology in the United States than Americans are in Japan. The Japanese closely monitor foreign patents. The Japanese are avid users of U.S. information services, and have gained access to U.S. technology by buying into U.S. companies or entering into marketing or production agreements with them. In many instances we could do likewise, but so far have not to the extent the Japanese have.

American organizations have, at least in the past, been remarkably open in allowing Japanese visitors to have access to their laboratories or factories -- to see, photograph, ask questions and take notes. Several persons have commented, however, that U.S. organizations are increasingly adopting strict policies in giving access to Japanese visitors, or are doing so only on a quid pro quo basis. The Japanese have taken full advantage of the traditional openness of American organizations, and continue to pursue this source of information avidly, even in the face of increased restrictions.

It would appear, on our initial review, that in the area of

basic research Japanese scientists have also generally been very open with their U.S. scientist counterparts, especially those with whom they have built a relationship over a period of years. Americans, however, have not taken advantage of this openness to the extent that the Japanese have. There are indications that as technologies become more production-oriented, and as visits become more formal and high level, it is more difficult to obtain access to Japanese laboratory and factory information particularly proprietary information.

U.S. scientists appear to be unanimous in their view that, relative to the United States, the Japanese either do not emphasize or do not excel at basic research. There are fields or sub-fields, such as cancer, in which the Japanese are now doing creative original basic research, and there are fields (amorphous metals) in which they appear to have made a policy decision to expand their basic research. However, one of the most common generalizations among American observers is that basic research still is not where Japanese strength lies. We should not be complacent, however. The Japanese have shown themselves adept at doing the necessary to maintain international economic competitiveness.

The Japanese genius lies in getting products to market. The Japanese establish objectives, both national and company, and pursue them in a coordinated way, with a minimum of

obstacles and distractions. Objectives tend to be framed in terms of development for production, sale and export. R&D performed in Japan tends to support these product-oriented objectives.

The Japanese appear able to conceive of commercial uses for a technology, acquire necessary basic research results from whatever source, target their R&D activities toward product development and production technology, and get a product to the market while U.S. researchers are still at the basic research stage. The product the Japanese market might not have been possible without the basic research which had been conducted in the United States or Europe, and they sometimes benefit from basic research performed in the U.S., but not yet applied by U.S. manufacturers. However, the result is that the Japanese all too often get a new product to market ahead of their competetors.

In essence, our preliminary information which we have shared with you today is being incorporated into the in-depth review of how to improve our S&T program with Japan. We expect to complete our review by the end of the summer or early fall. The results of our assessment will be the basis of our discussions with the Government of Japan. Since we are aware that they have also begun to undertake a similar review, the results of both our efforts will be utilized as we begin our negotiations on the S&T agreement which will expire in 1987.

Before closing, I would like to emphasize that there is a wealth of open sources of scientific information available in Japan. It is imperative that we improve our methods of collecting and using this information. I would also like to note that since the Japanese are at the vanguard in some high technology fields, increasing scientific cooperation with Japan will be more and more important to the U.S. in the years to come.

This completes our written testimony. We are pleased to answer any questions you or members of your Subcommittee wish to put before us today. Thank you very much.

DEPARTMENT OF STATE

Washington, D.C. 20520

CHARLES HORNER

Charles Horner has been Deputy Assistant Secretary of State for Science and Technology since October 1981. Previously, he had been Adjunct Professor and Research Associate of the Landegger Program in International Business Diplomacy in Georgetown University's School of Foreign Service. He was also a member of the United States Delegation to the United Nations Conference on the Law of the Sea. His earlier service in government had been in the United States Senate, where he was a member of the professional staff of the Subcommittee on National Security and International Operations and, later, senior legislative assistant in the office of Senator Daniel P. Moynihan.

Horner is a graduate of the University of Pennsylvania and did post-graduate work at the University of Chicago. He also studied overseas in Taiwan and Japan.

Horner is married and has two children.

Mr. WALGREN. Thank you. We appreciate that.

Mr. Mu.

Mr. MU. Thank you, Mr. Chairman.

I would like to comment today on the pilot project that we are sponsoring at the Department of Commerce International Trade Administration together with the National Science Foundation to study Japanese advancements in four critical areas——

In fiscal year 1984, the Department of Commerce, together with the National Science Foundation, sponsored a pilot project to study Japanese advancements in four critical industrial sectors. They were computer science, mechatronics, nonsilicon based microelectronics, and biotechnology.

The technical assessments were to be developed by four separate panels comprised of experts from industry, the scientific community, and Government, and the final products were to be reports on each of the assessments.

I think an aspect of the program that we would want to interject is that in our selection of these experts, most of the panelists came with not only the technical knowledge but in most cases were leading experts in assessing or knowledge of what their Japanese counterparts were doing at the same time.

With that panel, our goals, or one of the things we were looking at was if we supplied Japanese S&T literature that were not translated or not normally translated on a selective basis to the panelists, would they assess the state of that sector any differently than an assessment from available English literature only. So that we were looking for two end products as a result of this program. One as a technical assessment, the second was really an assessment of the S&T literature both as it appears in the open English sources and those that were supplied and translated by the contractor.

As I said, the final product is the report on each of these sectors which would cover the evolution of the state of the art of each of these sectors, the key players, the status of Japanese R&D, the trend and future directions of where they are going, any potential surprises or breakthroughs that the panelists have discovered, and to compare that with United States efforts here in the United States.

Also in the final report, we are looking for what is the expected commercial impact of the Japanese R&D for United States industries and what recommendations would they make.

In addition to the technical assessments that would be the final report, as I said, an important objective of this program was to identify relevant and timely Japanese S&T sources of materials, and incorporate it into the final report and on assessments of Japanese language source literature that they feel should be acquired and disseminated to the United States technical community on a technical basis.

As of this date we have one completed final report in computer science. The other three are in their final drafting stages, and all of them will be available for dissemination at the end of August of this year.

I would be happy to answer questions.

[The prepared statement of Mr. Mu follows:]

Statement For The Record
George Mu
Office of Japan
Department of Commerce
Subcommittee on Science, Research
and Technology

June 27, 1985

It is a pleasure to present this statement for the Record to the Subcommittee on Science, Research and Technology. I wish to comment on the International Trade Administration of the Department of Commerce's pilot program of assessing Japanese technical advancements in four critical industrial sectors. In addition, I would stress the need to accelerate the acquisition and translation of Japanese scientific and technical literature to increase the utilization of this information to strengthen U.S. competitive posture.

Repeated reports of Japanese innovations and growing dominance in the high technology industries have ceased to surprise U.S. researchers. The ability of Japanese firms to access the large base of R&D literature and activities in the U.S. has given them a competitive edge in responding to U.S. developments and trends on a timely basis. The reverse of this situation for the U.S. is not true. A significant gap exists between available translated Japanese technical literature and the wealth of untranslated technical texts that exist in Japan. In an effort to narrow this gap and to assess the competitive position of select Japanese sectors, the International Trade Administration of the Department of Commerce and the National Science Foundation sponsored a

pilot program in FY'84 to study Japanese advancements in four critical industrial sectors--computer science, mechatronics, nonsilicon based microelectronics and biotechnology.

The technical assessments were to be developed by four separate panels, one for each sector, comprised of leading authorities from industry, the scientific community and government. Each panel relied heavily upon scientific and technical information from a translation service established by the contractor. An important feature of this pilot program was that the contractor worked closely with the panelists in identifying and translating Japanese scientific and technical information for dissemination to the appropriate panels for assessment.

The final product of each of the panels will be a report based upon the assessment of Japanese science and technology publications available and the accumulated knowledge of the panelists to include:

- a history and background information describing how the Japanese have reached their present position in the said industry.

- an in-depth analysis of the current and projected state-of-the-art of the technology.

- a qualitative judgement of the creativity of Japanese research and development efforts and an analysis of how effectively results are channeled from government and university laboratories to the private sector for commercial purposes.

- an identification and analysis of key Japanese personnel, government and private institutions and the interaction among them.

- projections (including milestones) of expected progress and breakthroughs by Japan in the development and advancement of the technology.

- forecasts of the future consequences of such technological breakthroughs for specific sectors of Japanese industry as compared with corresponding U.S. sectors.

- a description and an evaluation of Japanese activities and programs that support these technological developments.

- a description and evaluation of the Japanese government's policy with regard to transfer of technology.

- panelists' reactions to unanticipated Japanese procedures, areas of research or other concerns of which they were previously unaware because of cultural or institutional barriers.

While it is still too early to prejudge the results of this project, the response and interest from the scientific, business and trade community based on workshops and presentations at trade association meetings by each panel of their findings to date have been well-received. The Department of Commerce is confident the final reports will be highly professional technical assessments of the commercial and competitive position of the Japanese industry in the selected sectors and of the implications for affected U.S. industries. We expect to gain insights based on our experience of accessing, translating and surveying Japanese sciences and technology literature which have not been traditionally available. In addition, we expect to be better able to comment on the quality of R&D in Japan, to assess how many of the significant developments in Japan are translated into English, and to suggest ways and means to increase the utilization of this information to meet American competitive requirements.

The computer science report has been completed and draft final reports from the nonsilicon based microelectronics and mechatronic panels are under review. We expect all final reports to be completed and ready for dissemination by the end of August 1985.

Mr. WALGREN. Dr. Ambler.

Dr. AMBLER. Thank you, Mr. Chairman, members of the subcommittee.

I am very pleased to be here to discuss the role of technical information in United States competitiveness with Japan. I have with me Dr. Edward Brady, our Associate Director for International Affairs, who is on my right.

Dr. Brady was program chairman for the conference held earlier this week at the National Bureau of Standards on accessing Japanese technical literature, and we were very pleased to have you there, Mr. Chairman, to be the keynote speaker.

In your letter you asked a number of questions. First is how does the National Bureau of Standards keep up with worldwide technical investments? I think the simple answer to that is on the whole I believe we do very well, but it isn't very easy to do it, and I suppose we could do better.

Principally, we expect all our professionals to be aware of what is going on in their fields throughout the world. Experience has convinced us the most effective method for transferring information and transferring technology for that matter is on a person to person basis.

If we relied only on published literature we would certainly lag constantly behind. Finding important information in this mountain of information, most of which for an individual's purposes would be irrelevant, is not easy. If the language is Japanese the problem is even more difficult. Some technical groups are better organized to address the problem than others. For example, physicists as a group feel their access to Japanese developments is as adequate as for most other foreign languages.

On the other hand, the coverage for disciplines close to commercial applications is not nearly so good. That is why we focused the conference at NBS earlier this week on electrical engineering and electronics. The main conclusions of it was that the great majority of Japanese work in microelectronics is not available to the non-Japanese reading world in a timely way.

Numerous small activities are underway to cope with the problem but none compare with the international efforts of the physic's community.

We hope the engineering societies, with industry support, will be stimulated to address the problems illuminated by our seminar in a serious effective manner. You asked several other questions in your letter of invitation, Mr. Chairman, and in my written statement I tried to cover them, so in the interest of time I would like to summarize my main points.

All scientific staff in a research organization like the National Bureau of Standards should be responsible for keeping up to date with technical advances in other first class laboratories.

For competitive reasons Japan is the first priority. The most effective and timely manner of obtaining scientific information is through person to person communication.

This should be part of doing business for a Government or industrial laboratory. In addition, we have found the Japanese technical community open and willing to share information short of that the information having direct proprietary applications. We must expect to share similiar knowledge in return.

Limited United States capability with the Japanese language remains a barrier within personal relationships and reviewing technical literature.

Surplus foreign currency programs are sometimes useful for obtaining translations of foreign literature. It is a slow process, so this approach cannot meet our needs in fast moving competitive fields.

Active U.S. participation in the international standards making process and formal scientific exchange agreements can also be effective ways of keeping up with foreign developments.

Finally, I want to stress that it does not in my view make sense to undertake massive programs for translating the Japanese technical literature.

The more targeted approach, such as that being used by the American Institute of Physics and covering physical sciences is what is needed. The professional engineering societies such as the IEEE should be encouraged to move with support from industry, toward strengthening the weaker coverage of the Japanese literature.

Thank you very much, Mr. Chairman. I would be glad to answer any questions.

[The prepared statement and biographical sketch of Dr. Ambler follow:]

U.S. DEPARTMENT OF COMMERCE

STATEMENT OF ERNEST AMBLER, DIRECTOR

NATIONAL BUREAU OF STANDARDS

BEFORE THE SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY

COMMITTEE ON SCIENCE AND TECHNOLOGY

ON THE ROLE OF TECHNICAL INFORMATION IN U.S. COMPETITIVENESS WITH JAPAN

JUNE 27, 1985

Mr. Chairman and Members of the Subcommittee:

I am pleased to have this opportunity to discuss the role of technical information in U.S. competitiveness with Japan and more specifically how NBS keeps up with what the Japanese are doing, particularly in such critical areas as materials science, computer science, electronics, and robotics.

I would like to introduce Dr. Edward L. Brady, our Associate Director for International Affairs, who is accompanying me today. Dr. Brady has just served as Program Chairman for the Conference held these past two days at the National Bureau of Standards (NBS) on accessing Japanese technical literature.

How does NBS keep up with world-wide technical developments? On the whole, I believe we do very well, but it isn't easy. We expect all our professionals to be aware of what's going on in their fields throughout the world. Our years of experience have convinced us that the most effective method of transferring information, as well as technology, is on a person-to-person basis, preferably between people involved in similar research. Indeed, if we relied only on published literature, we would certainly lag constantly behind the forefront of

science and technology because the published literature inevitably appears months, or sometimes years, later than the generation of new and exciting developments. New information usually is first revealed at a person-to-person meeting, either at an international conference, or during exchange visits. These activities are essential elements in our steady effort to keep up. I encourage NBS scientists and engineers to attend important international meetings, to maintain close professional relationships with foreign colleagues, to participate in exchange programs and to become members of international scientific groups.

To be aware of the really hottest new information, one must be a recognized member of the "invisible college" in one's field--that informal confederation of colleagues who keep in touch by mail, by telephone, and by personal meetings, both because they don't want to miss anything new and because they want the right people to know what great things they themselves have just achieved. The Japanese participate in such invisible colleges, and our staff have found Japanese institutions and researchers quite willing to share information of a non-commercial nature.

THE TECHNICAL LITERATURE

I do not want to appear to claim too much for personal communication. This is a necessary, but not a sufficient condition for maintaining current awareness. Personal communication must be supplemented by the archival records. Technical periodicals published throughout the world now number in the tens, or perhaps even hundreds, of thousands. Finding the important nuggets of knowledge in this mountain of irrelevancies is not easy. Fortunately, in any specialized field, the majority of significant contributions appear in a relatively small number of journals, perhaps 40 or 50. Another difficulty derives from the multiplicity of languages in which information is recorded. In this regard we

in this country are lucky; it is often said that the international language of science and technology is broken English. Regardless of the accent of the author, the English on the printed page is intelligible to someone who understands the subject matter. If the language is not English, however, we have difficulty. For the major European languages—French, German, Spanish, even Russian—American technical people often can gather at least the gist of the article, and decide if they want a translation. In addition, translators for these languages are easy to find, and an English language version is readily obtained. But if the language is Japanese, the problem is much more difficult. Few American scientists and engineers can recognize even one Japanese character and the differences between kanji and katakana are beyond our comprehension.

We at NBS are especially fortunate. Among our professional staff we have people who can speak and read all the Western European languages, plus Russian, Czech, Serbo-Croatian, Hungarian, Romanian and Polish among the Eastern European languages. Among the Asian languages we can handle Chinese, Korean, Japanese, Hindi, and two or three other Indian languages. So if we have an urgent requirement we can call on one of our staff. But relying on our own staff cannot be a general solution.

Since the problem is too large for individuals to solve, the technical community has pooled resources to produce various aids for finding relevant material. Professional indexing and abstracting services--such as Physics Abstracts, Chemical Abstracts, Engineering Index, and Government Reports Index--list bibliographic data and give English abstracts for hundreds of thousands of journal articles and reports. They cover papers appearing in many languages, including Russian and Japanese. For the basic sciences, particularly physics and chemistry, the coverage of foreign language literature is particularly effective. The American Institute of Physics has for many

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years published cover-to-cover translations of the most important Soviet physics journals. I am also told that the most important Japanese reports in physics are written in English or at least are covered by English language abstracts. For these reasons, physicists as a group feel that their access to Japanese developments is as adequate as for most languages other than English.

For other disciplines, particularly those close to commercial applications, the coverage is not nearly so good. Electrical engineering and electronics are examples. We have just completed a two-day seminar at NBS, jointly sponsored with IEEE, to examine in detail the issues connected with U.S. access to Japanese information in this field and to explore what services now exist and what could be planned. Our seminar concluded that Americans in these disciplines have serious problems in finding out what has been reported that is of interest.

A wide spectrum of Japanese journals in electronics is available only in Japanese. For example, at least 26 technical journals regularly publish articles on microelectronic materials, processes, and devices. In addition, about ten house publications of important companies and government laboratories and irregular technical publications of trade associations appear only in Japanese.

Some journals and company publications have an English edition. These contain only selected articles from the Japanese originals and typically appear a year later than the originals. It is safe to say that the great majority of current Japanese work in microelectronics is not available to the non-Japanese-reading world in a timely way.

The technical quality of Japanese work has risen sharply over the last decade and now is fully equal to ours or anyone else's. Ten years ago, really good Japanese contributions to the two major U.S. microelectronics meetings, the International Electron Devices Meeting and the International Solid State Circuits Conference, were rare. Both of these meetings attract many more submitted abstracts than can be accepted, so the selection standards are very high. Today, the selection committees have a hard time holding the Japanese contributions down to 50 percent of the accepted papers to leave room for the rest of the world.

Our seminar made a survey to determine what professional societies and trade associations are doing, what private sector commercial organizations are doing, and what government agencies are doing. Numerous small scale activities are underway but there is nothing to compare with the systematic efforts of the physics community. We hope that the engineering community will be stimulated to address the problems illuminated by our seminar in a serious and effective manner. This appears to be an area where a Federal government program is not the answer. The engineering societies with industry support would be a preferable alternative.

OTHER EXAMPLES OF EXCHANGE FROM NBS EXPERIENCE

Information on foreign science and technology also flows to us from our foreign guest scientists and engineers, who at the present time represent the technical communities of some 40 different countries. These individuals work in our laboratories with our own staff members, contributing their skills, their ideas, and their knowledge to the partnership. Of course, the flow of information goes in both directions. We are very much aware of the

possibilities for undesirable technology transfer outside of our own national borders, and we do not accept guest workers into those laboratories engaged in work considered "sensitive", even though unclassified. In the reverse direction, we send our staff members overseas also, although we do not send nearly so many as we receive. Our people regularly go to PTB in Germany, to the National Physical Laboratory in the U.K., and to the National Research Council in Canada. We have an especially productive cooperative program on cold neutron research with the Institut Laue-Langevin in Grenoble, France. We have long-term programs with Japanese institutions on wind and seismic effects on construction and on fire research, under which we have sent people to work for several months in Tsukuba, the great science city of Japan. However, because of the language difficulty in Japan, we do not send nearly as many of our staff there as I would like.

As a specific example, let me use advanced ceramics, a part of the active field of materials science. NBS researchers and technologists have become quite knowledgeable about Japanese ceramics research and development through information gleaned from a number of sources. Although we are greatly limited in utilizing the Japanese literature, largely because of the language barrier, we have been able to make extensive and profitable use of information provided in translations of Japanese publications. Direct interactions between NBS scientists and Japanese ceramists have been one means of obtaining up-to-date information. A more improved means of information collection are the individual interactions between NBS staff and individuals who have cooperated with Japanese ceramists and who have developed mutual trust, friendship, and a capability for a "quid pro quo". In 1984 NBS sponsored a major study by Charles River Associates of the technology and economic asessment of advanced ceramic materials. The findings of this study have attracted a lot of

industrial attention. To help U.S. industry capitalize on this information, NBS and OPTI have organized a Department of Commerce Conference on July 10 and 11, 1985, entitled "A National Prospectus on the Future of the U.S. Advanced Ceramics Industry". Its objective is to identify and access critical issues affecting the competitive position of U.S. industry in this world market, and to develop approaches to cooperative industrial R&D and associated efforts.

Another area where I can describe NBS experiences assessing Japanese developments is in robotics and flexible manufacturing systems. About two years ago, early in our work on the NBS Automated Manufacturing Research Facility (AMRF), we sent a delegation to the flexible manufacturing complex then being started at the MITI Electrotechnical Laboratory in Tsukuba. We also met with some of the many companies involved. In all of these exchanges, our Japanese hosts appeared very open in discussions of their work. A year later, when they visited us, they brought with them extensive documentation on their facility and progress. Our assessment of their activities in this area has been helpful not only to us but also to the U.S. firms working with us on the AMRF.

THE ROLE OF INTERNATIONAL STANDARDS

The product and engineering standard-making process also plays an important role in the exchange of technical information. In the United States and in international forums, technical standardization activities are open, thereby providing all participants and the general public with access to the shared information. The competitive position of U.S. manufacturers and exporters is enhanced greatly when effective actions by U.S. technical representatives result in international adoption of U.S. standards or technology. Private

sector companies told us in a recent study that they send delegates to international meetings to obtain information about technical developments in other countries; to learn of pending foreign rules and certification practices; and to make contacts for increased business and profits abroad.

More than 700 Federal, state and private organizations develop product and engineering standards in the U.S. and more than 425 of these are voluntary, private groups, unsubsidized by government, although many Federal experts participate in the standards-development activities of these organizations. At NBS, approximately 500 technical experts from NBS participate in the work of more than 1000 committees of approximately 100 different national and international standards organizations.

Literally thousands of foreigners belong to U.S. standards organizations, especially the professional societies that also issue standards. Their presence at meetings and their technical contributions permit a two-way exchange of information. The Japanese are noteworthy for the extent of their memberships in U.S. organizations and standards-writing committees. They tend to be reasonably fluent in the language of discourse--English; in contrast, few actual or would-be U.S. participants in Japanese activities are conversant with Japanese. At the same time Japanese firms appear not to depend on using international standards to gain competitive advantage--their strategy is to manufacture products better, cheaper and faster.

NBS work in standards development is exemplified by the key role that the Institute for Computer Sciences and Technology currently plays a key role in defining and validating the seven level data communication standards of the International Standards Organization (ISO). Compatibility with similar U.S. standards will allow maximum commercial participation in these growing world markets for equipment and services.

ROLE OF FOREIGN CURRENCY

In some cases, surplus foreign currency can be used to obtain economical translation of foreign technical literature. At present surplus foreign currency is available only in India and Pakistan. With appropriate legislative approval, a Federal agency can have access to this surplus for support of its programs. We have successfully used this approach to translate Russian books and are in the process of arranging translation of Japanese books.

A characteristic of such foreign translation severely limiting its usefulness is its slowness. Using overseas translation services in either India or Pakistan requires six to twelve months. Because of this, in highly competitive fields such as microelectronics where technology advances rapidly, this translation process is not practical for current awareness. Of course, it is also not a substitute for the person-to-person, technical interaction I described earlier since an additional delay is added to the already major delay of publication. Another significant problem is the low volume of material that the foreign translation services can handle; the Indian and Pakistan services combined can translate only about 2000 pages per year.

ROLE OF EXCHANGE AGREEMENTS

Formal agreements between governments or governmental agencies for the exchange of scientific information and personnel sometimes facilitate the process. In general, peer level communications proceed without special incentives. In some cases foreign governments desire formal agreements in order to eliminate certain barriers or to obtain special resources. For example, in the past NBS has benefited through having exchange agreements with particular scientific laboratories in the U.S.S.R.

I also want to mention an exchange agreement signed about 18 months ago between NBS and the Nippon Telegraph and Telephone Company laboratories. There has already been an exchange of teams of senior officials to review major research programs and a staff exchange in fiber optics, where the Japanese are ahead of most U.S. efforts. We hope that one benefit of this program to NBS, and hence to U.S. industry, will be to learn at the earliest possible stage about the research areas that will later end up as equipment or new technology in the Japanese telephone/data communications system.

SUMMARY

Let me summarize the main points I have made relative to your areas of interest at these hearings.

- All scientific staff in a research organization like NBS should be held responsible for keeping up to date with technical advances in other first class laboratories. For competitive reasons, Japan is of first priority.

- The most effective and timely method of obtaining scientific information is through person-to-person communication with other researchers. This type of person-to-person exchange is part of doing business for a government or industrial laboratory.

- We have found the Japanese technical community open and willing to share information, short of that having direct proprietary application. We must expect to share similar knowledge in return.

- Limited U.S. capability with the Japanese language remains a barrier, both in personal relationships and in reviewing technical literature.

- Systematic review and translation of Japanese technical literature varies greatly by fields: Physics is well covered by the American Institute of Physics activities while coverage of engineering areas is weak.

- Professional engineering societies, such as the IEEE, should be encouraged to move, with support from industry, toward providing similar coverage of the Japanese engineering literature.

- Active U.S. participation in the international standards making process is an effective way of obtaining access to foreign-based technological developments as well as of encouraging adoption of U.S. standards and technologies.

- Surplus foreign currency is useful for obtaining translations of Japanese and other foreign literature on a limited scale, but the long period required means this approach cannot meet the needs of fast moving technologies in competitive fields.

- Formal scientific exchange agreements are not a prerequisite for successful access to technical information, but can be useful in some special cases.

Thank you for the opportunity to share this information with you. Dr. Brady and I will be glad to respond to questions.

UNITED STATES DEPARTMENT OF COMMERCE
National Bureau of Standards
Gaithersburg, Maryland 20899
OFFICE OF THE DIRECTOR

FEBRUARY 1985

ERNEST AMBLER, DIRECTOR

Dr. Ernest Ambler became the eighth Director of the National Bureau of Standards in February 1978. At the request of Secretary of Commerce Malcolm Baldrige, he has continued as Director for the Reagan Administration. Dr. Ambler joined NBS in 1953 and has worked throughout his career to make NBS an increasingly valuable scientific and technical resource for industry, business, government, education, and the public.

As Director of NBS, Dr. Ambler leads the Nation's measurement laboratory in the physical sciences and engineering. NBS directly supports the commerce, industry, and science of the Nation by producing and delivering measurement products and services. These products and services provide the basis for the exchange of goods, the accurate specification of products, quality control methods for production, and scientific advances. NBS contributes directly to the competitiveness of U.S. industry by maintaining and improving the Nation's measurement capabilities. The Bureau's headquarters are located in Gaithersburg, Maryland, with a second laboratory in Boulder, Colorado.

As a scientist, he has contributed directly to the state-of-the-art in measurement technology. His expertise in nuclear physics and cryogenics formed the basis in 1956 for a cooperative effort that disproved the law of parity conservation, a concept that nuclear scientists had adhered to for more than 30 years. This pioneering project confirmed experimentally the theoretical work of Nobel Prize winners T. D. Lee and C. N. Yang.

As an administrator, Dr. Ambler has helped guide Bureau operations and policies to improve the efficiency with which NBS fulfills its mission. His management responsibilities began in 1961 when he became Chief of the Cryogenic Physics Section. Four years later he was appointed Chief of the Inorganic Materials Division. In 1968, as Director of the Institute for Basic Standards, he assumed responsibility for directing the most basic of NBS research activities: developing and maintaining standard and measurement techniques for such quantities as length, mass, time and frequency, and temperature. He was appointed Deputy Director of NBS in 1973, and Acting Director in 1975.

Among Dr. Ambler's continuing concerns is the Bureau's role in international science. He has long acknowledged that through its mission and diversity, the Bureau can act as a prime agent in international scientific cooperation and can support U.S. foreign commerce through participation in international standardization activities. In 1972 Dr. Ambler was elected to serve as the U.S. representative to the International Committee of Weights and Measures (CIPM), the executive body of the General Conference of Weights and Measures. He is chairman of that organization's Consultative Committee of Standards for Measuring Ionizing Radiation and Consultative Committee of Electricity. He became the Department of Commerce member on the Board of Governors of the Israel/U.S. Binational Industrial Research and Development Foundation in September 1981.

Dr. Ambler is a member of the American Association for the Advancement of Science, a fellow of the American Physical Society, and as Director of NBS, is ex officio President of the National Conference on Weights and Measures. He was commissioned by the Governor of Maryland in 1983 to serve on Maryland's High Technology Roundtable. He serves on the Commission on Higher Education for Maryland's Montgomery County Government.

Dr. Ambler is the recipient of numerous honors, awards, and fellowships including: The Department of Commerce Gold Medal, the NBS Stratton Award, Nuffield Fellow of Oxford University, the John Simon Guggenheim Memorial Foundation Fellowship Award, the John Price Wetherill Medal of the Franklin Institute, the Washington Academy of Sciences Award, the Arthur S. Flemming Award, the William A. Wildhack Award, and the President's Award for Distinquished Federal Civilian Service. He authored 52 publications and holds a patent for low temperature refrigeration apparatus and processes.

Born in Bradford, Yorkshire, England, in 1923, Dr. Ambler earned his B.A., M.A., and Ph.D. in physics at Oxford University before coming to the National Bureau of Standards. He became a United States citizen in 1958. Dr. Ambler and his wife, Alice Seiler Ambler, a former staff member in the NBS Heat and Building Research Divisions, were married in 1955. They live in Bethesda, Maryland, and have two sons, Christopher and Jonathan.

Mr. WALGREN. Well, let me ask Dr. Caponio, you mentioned this agreement that you are pursuing with respect to accessing the data base. That comes from whom again over there?

Dr. CAPONIO. That comes from the Japanese Information Center of Science and Technology.

Mr. WALGREN. That is the group that tries to publish——

Dr. CAPONIO. That is the same source of scientific and technical information in Japan, as well as the agency which deals cooperatively on a bilateral basis with other governments, including the United States.

Mr. WALGREN. How do you react to the thought as raised by the witness from General Motors that that group has only put out 33 publications this year compared to the 30,000 that are detailed—well, that apparently are published in the literature from the west?

Dr. CAPONIO. Mr. Chairman, I think in order to place this whole topic in perspective, one has to understand that when we are talking about the technology literature or the technical report literature we have to consider that in contra-distinction to the scientific literature which appears in the scientific or scholarly publication.

In the United States, for example, we are expending approximately $60 billion worth of research and development, the results of which are either published in scientific and scholarly journals, that emanate from pure basic or fundamental research.

On the other hand, the applied research, which usually emanates from some of the mission-oriented agencies such as the Department of Defense, NASA, the Department of Energy and other agencies, that results in the technical report literature. Putting this into context, NTIS being the focal point for the acquisition and the dissemination of the technical report literature, out of 60 billion dollars' worth of R&D approximately 50,000 technical reports are made available every year.

This contrasts with the Japanese situation and we do not have a precise figure, but it is estimated that maybe between 10,000 and 20,000 technical reports are generated through the cooperative arrangements between the Government and the private sector.

We have access, we believe, to most of the technical report literature, but again, the basic problem, most of the technical report literature is in Japanese; and I dare say that we will have available to us most of the technical report literature emanating from these government agencies under the auspices of MITI but, again, it is the question of translation.

Mr. WALGREN. You feel the base they are working from is somewhere between 10,000 and 20,000 and we see 33 of that in 1985, and——

Dr. CAPONIO. I would also like to add, in trying to clarify the situation with respect to the acquisition of additional technical report literature, there is an organization in the executive branch known as CENDI, Commerce, Energy, NASA, and Defense Information.

As a result of bilateral exchange with all of these agencies, we are able to acquire many additional technical reports in the field of aerospace, energy, and in our case, the industrial technology. As a result of our direct acquisitions with Japan, I would say that in the past year we have probably received close to a total of 20,000 tech-

nical reports of foreign origin. Perhaps 1,000 to 1,500 of which are from Japan.

Mr. WALGREN. And they are in Japanese.

Dr. CAPONIO. Much of the technical reports are in the Japanese language. They are not translated into English.

Mr. WALGREN. This is the data base that you talk about negotiating access to; that data base, is that abstracts?

Dr. CAPONIO. The data base, within the JICST; there are several different kinds of data bases but yes, Mr. Chairman, they are all abstracts and in some cases the abstracts are just in Japanese.

Mr. WALGREN. Are you going to be able to translate those that you can call up in there? Do you have that kind of an effort or plan? It doesn't seem like it would be the toughest thing in the world to translate 10,000 abstracts.

Dr. CAPONIO. I believe we will, as a result of the cooperative arrangements, be able to at least have the abstracts translated into English.

Mr. WALGREN. They haven't offered to do that themselves, have they?

Dr. CAPONIO. Not entirely, but they are working on it. They have made promises on behalf of the Japanese Government that eventually much of the abstracts will be translated into English.

Mr. WALGREN. Do they give you timeframes on that?

Dr. CAPONIO. No, Mr. Chairman. But we expect to have perhaps the first on-line access maybe at the end of this year or the beginning of next year.

Mr. WALGREN. How big a job are we talking about to translate those abstracts in the data base? How many man months would it take a good translator to translate that?

Dr. CAPONIO. I couldn't give you a precise answer, but it is a large effort. I would have to check to see just exactly how much manpower would be required to translate. Offhand I don't know.

Mr. WALGREN. Is an abstract generally more than a page?

Dr. CAPONIO. Usually an informative abstract consists of about 250 words.

Mr. WALGREN. If I am remembering right—what do we get on a page?

Mr. HORNER. About 200.

Mr. WALGREN. It would cost 70 bucks, as I understand it, to do one abstract. If you did a thousand abstracts it would cost us $70,000. Well, I hope that you will approach that with some effort because obviously, it is a possibility——

Dr. AMBLER. May I make a small comment? Dr. Brady points out to me that at the seminar we learned that the JICST is developing an English language data base for their index and abstracts that will be available they say in about a year, which is, I think, the time you were asking about. That is information we picked up at the seminar.

Mr. WALGREN. That is good to know. I would hope we would confirm that. That seems to be the least we could ask, and certainly something relatively reasonable to ask.

Mr. BOEHLERT. Give me some comparative figures if you are able to do so. How large a presence does our Department of Commerce

have in Japan as opposed to their counterpart's presence in the United States?

Mr. MU. We are talking about the International Trade Administration?

Mr. BOEHLERT. I am trying to compare apples and apples.

Mr. MU. In our Embassy together with our consulate in Osaka we have commercial officers in Japan. MITI in their Embassy—and I am only aware of their officers in Washington, DC, and New York—will have 11 MITI officers here in the United States. MITI also staffs some of the trade offices, the trade promotion offices, particularly the Japan Trade Center, and I would imagine if you take the offices from Chicago, Houston, Los Angeles, and New York, you would probably get another dozen officers. Those are primarily trade promotion officers.

Mr. BOEHLERT. That is not a great imbalance, then.

Would a Japanese businessman openly and willingly share information for example with MITI, Japanese businessmen doing business here in the United States, come upon information through any of a variety of means they think might be helpful? Would they be—from your experience—very willing to share this with the Government with the thought the Government should share it with others, or would they view it as primary?

Mr. MU. It is done all the time.

Mr. BOEHLERT. How about our American businessmen, are they very open and saying to your people in Japan, I think this might be of interest to others?

Mr. MU. That also takes place. I want to also say that in Japan the Chamber of Commerce is probably unique as chambers of commerce go overseas. They are very, very active. The American Chamber of Commerce in Japan has a membership of approximately 700 United States companies. They are set up in a very formalized committee structure. Very little is done in the trade or policy areas without their participation. I mean, yes, we do share. They do share.

Mr. BOEHLERT. The Diet is set up somewhat like the Congress, isn't it, with the committees and hearings?

Mr. MU. Yes.

Mr. BOEHLERT. If a hearing like this were taking place in Japan right now, would we have a noticeably United States presence at that hearing to monitor it?

Mr. MU. No, sir.

Mr. BOEHLERT. There is a deficiency because I think it doesn't work the same way the other way around.

Mr. MU. It is not because you cannot go.

Mr. BOEHLERT. It is a resource problem.

Mr. MU. That is right.

Mr. BOEHLERT. Dr. Ambler—I agree with you—you talked about the most effective manner of obtaining scientific information is through person-to-person communications and exchange.

I would assume from that, I would followthrough, it would be in our best interests to have some of your key people traveling to Japan, open communication, but you have got some serious budget problems. Is your budget adequate in this area to allow your people

to do what you think your people should be doing? That is a tough question.

Dr. AMBLER. You can answer that very well because of our authorization hearing and several things. Let me say, though, we are using what resources we have as effectively as we can, and we do prioritize travel to Japan. The kind you are talking about would be absolutely high priority. I don't think that particular area is suffering because of budget restrictions.

Mr. BOEHLERT. I am glad to hear that.

Mr. Horner, would the State Department role be encouraging the type of thing we heard about yesterday during our hearing? Dr. James Fry of Cornell is on a 1-year sabbatical over in Japan, and while there he is putting out an excellent publication he is sending back here that is being used to great advantage by a number of people in industry.

What kind of fellowships do we have in the State Department? Do we have enough, should we be encouraging more? It just seems to me—and this is an untutored general observation—it seems to me there is a decided Japanese presence certainly in Washington, but in the United States, aggressively seeking out information that might be of value back home. I am not certain it works the other way around, that we are as aggressive as we should be.

A number of our witnesses have said it is not all that difficult to get answers to questions in Japan if we ask the questions. Oftentimes I don't think we are asking the questions. It is sort of a real broad—I will give you a big paintbrush to paint with.

Mr. HORNER. Some years ago I was a student in Japan in an exchange program at a time when area studies in the United States were generously supported by the Ford Foundation and others. So, I think what I ought to do in responding to your question is to respond as someone who has had the experience of living in Japan, rather than as someone who, at the moment, happens to be an employee of the Department of State.

The relationship, as you point out, is quite unbalanced, and it is quite unbalanced for many reasons. One obvious reason is that there are very few Americans who can speak, and even fewer who can read, Japanese.

But I think we must also recognize that there are strong incentives for the Japanese to keep the arrangements the way they are regardless of how many Americans speak Japanese, no matter how proficient Americans become in the speaking and reading of Japanese: When you ask why is it that we do not get more information, why do we not have more access, the real answer is that they do not see it as in their interest for us to do so.

The question, therefore, is how do we create a situation where they see progressively that it is more and more in their interest for them to have more open relations. Now, there are many ways in which one can try to influence their practices in this area. We try, for example, to place more Americans in Government-sponsored laboratories in Japan.

The number of Japanese scientists in United States installations is much greater than the corresponding number of Americans in Japan. But we have to recognize that what we can achieve in changing Japanese policy and attitude on this question is going to

be, at least for now, extremely limited. Let me give you one example.

If you say to the Japanese they ought to have a policy on the release of technical information produced from Government-funded research that is similar to our own, that they ought to have, if you will, a National Technical Information Service which operates like our own, they will think that is simply crazy.

Most nations around the world like this policy of ours. They don't quite understand why we have it, but they like it very much. It is much in their interest. It is very difficult to develop a bargaining position, for the exchange of Government-produced data when on our side it is all freely available.

Indeed, as you may remember, the Secretary of Commerce wrote to his colleague a while ago saying that not merely do we release data in enormous quantities, but that some of it has a good amount of security sensitivity. So we have adopted a practice in this country which makes sense to us and is of no doubt of great benefit to us, but no one else in the world has such a policy.

Mr. BOEHLERT. I understand what we are doing——

Mr. HORNER. My point is, when you say to them you ought to do it our way the question they will always ask is, why? And it is a very protracted and difficult undertaking to deal with these kinds of practices. For example when I lived in Japan in 1970, there was a question of availability of sale of American cigarettes. I had become much addicted to the smoking of Lucky Strike cigarettes and, 15 years ago greater availability of American tobacco products was imminent. Fifteen years later, it's still imminent. I don't know how much this proves, that we do not have the ability to control the relationship on our own side, it is very difficult to develop any real bargaining power with the Japanese.

Mr. BOEHLERT. I understand that and I tell my favorite story about the great national game in Japan being baseball. In upstate New York, there is a company that manufactures one of the finest baseball bats known to man, Adirondack, but they cannot be exported to Japan because American made baseball bats don't meet Japanese safety standards. I know about the barriers.

The real thrust of my question is to try to find out what the State Department is doing to help finance and help guarantee that we have greater American presence in Japan in terms of fellowships, people at universities, that type of activity.

Mr. HORNER. In the first case, we would like to see, and I am sure all our colleagues in the Department of Commerce would like to see, far greater awareness among our enterprises and larger corporations in order to have a larger presence of their own in Japan.

Now, I can't speak for General Motors. The question is whether or not two people are adequate to its own needs. It seems to me not, but I am not in charge of General Motors.

There are other people who have a direct stake in knowing the status of Japanese proficiency so we try to encourage their learning about it. We try to encourage all of the Federal mission agencies, to engage in exchange relationsships with counterparts in Japan to the degree that they can.

If it were possible to introduce greater reciprocity into those relations, we would like it quite a lot. We have been very supportive of

the efforts of the Massachusetts Institute of Technology, and we were involved in getting that program going to alert people to the importance of the engineering and scientific vocabulary in the teaching of Japanese.

I, myself, have spent a time with Japanese studies programs trying to deal with the perception of Japan as mere esoterica. Traditionally, a good deal of American interest in Japan comes out of an interest in poetry, esthetics, and things of that sort. We have been lax in getting science and technology into our academic Japanese studies programs.

But my major point is it is very difficult, it is very painstaking to deal with a society and a country which has developed thoughts about foreign relations which are very, very different from our own.

Mr. BOEHLERT. Does the science counselor in Japan speak Japanese?

Mr. HORNER. He speaks some Japanese. But, you see, if I may say so, the Japanese do not like foreigners to speak Japanese. This is one of the most noticeable things one sees in Japan. A foreigner's speaking Japanese is considered unusual, unnerving, and unsettling, and it is one of the attributes in visitors and long-term foreign residents in Japan which is not very much encouraged. I think that the development of a proficiency in the Japanese language which overcomes this takes an awfully long time. Very few foreigners attain it.

Mr. BOEHLERT. Where does the science counselor in Japan get technical support?

Mr. HORNER. I am not sure I understand.

Mr. BOEHLERT. First of all, there is a language problem to start with, and maybe I don't understand enough of the Japanese culture, but I would think that in most nations where we send our top level people, are offended if we don't speak the language and understand the culture as well as we should. So if we send—how do we train science counselors, for example?

Mr. HORNER. Our science counselors have tended to come from a variety of different backgrounds usually in the Federal service, but other places as well. The one we have in Japan now has a background in nuclear engineering. We have a language training program in the Department of State that is quite good, and there are opportunities overseas to learn the language.

But the point I want to stress here is it is that though it is very important for people to know Japanese, it isn't decisive by any matter of means.

Mr. BOEHLERT. Thank you.

Mr. WALGREN. Let me ask Dr. Caponio, the NTIS uses revenue on sales, as I understand it; of your publications to fund the efforts in these areas? Does the revenue on the Japanese material fund an adequate effort in that area? Or do you really need a greater access to appropriated funds to make any real progress in this area?

Dr. CAPONIO. As you well know, the NTIS is mandated to be completely self-supporting to the extent feasible in all areas, and so we are attempting to operate the Japanese program on a self-supporting basis, and we are using some of the NTIS trust funds to carry out the activities. But there is always room for——

Mr. WALGREN. What is the total dollar value in the Japanese area?

Dr. CAPONIO. Approximately $250,000 is made available for the Japanese program.

Mr. WALGREN. I see.

Mr. Mu, you indicated that comparative assessments were being done and in some sense with the presently available English access and then also with a more complete Japanese source access, and you were going to be able to compare the conclusions of the two separately, is that right? So that you would be able to make some assessment here of the degree of the barrier that the present limitations in English are in these areas?

Mr. MU. Yes. I think it compares what we are more interested in—do you get a more accurate picture using Japanese source materials, selective Japanese source materials, than what would appear in the English summaries or papers from Japan itself? Do you learn something new? Are all the significant findings in the S&T published in English? If not, where do they occur? What is the timeliness of it occuring in English? If you go to the symposiums, the informal papers that are handwritten that are circulated, even in the government research associations which have quarterly meetings and circulate papers, would you learn more on a timely basis.

Some of them end up in publications, some do not. Do you learn more about the technical assessment where the Japanese are vis-a-vis your own competitiveness? Those are the questions that we were asking, not so much did it present a barrier. Did you learn more? Were those texts timely? What should we be looking at in addition to what is available in English as well?

Mr. WALGREN. Yes. But you will be able to make some judgment of the limitations on you without access to that second level.

Mr. MU. That is correct.

Mr. WALGREN. That I think may be the most interesting part of your study. And I would really hope if you could send us a survey or a summary of your findings and particularly that question, what do you lose by stopping at the level that we now stop at and what do you gain by going beyond?

Mr. MU. I would be glad to.

Mr. WALGREN. I think that might be the linchpin of an awful lot of our concern, and it might confirm that we ought to be doing an awful lot more in this area than we are. In a way that is what these hearings are all about. You seem to have a project which would give us some factual base for making that judgment as opposed to each person's anecdotal views. We really look forward to that.

Let me, on behalf of the committee, thank all of you for your contributions. We could go on, except we do have some real time constraints this morning. We hope to develop this area with you a little bit as we get our record and think back on it and read your testimony with real interest, and we hope that we can get you to develop some of the points that you have made with us after the hearing as well. We do appreciate your being an ongoing resource to us.

So with that, thank you very much, and we will conclude this morning's hearing.

[Whereupon, at 11:40 a.m., the subcommittee adjourned subject to the call of the Chair.]

APPENDIX

Additional Material for the Record

STATEMENT OF J. COYNE

ACCESS TO JAPANESE ENERGY-RELATED INFORMATION

Statement submitted to Hearing before House Science and Technology, Subcommittee on Science Research and Technology on Role of Technical Information in U.S. Competitiveness with Japan by **Joseph G. Coyne**, Manager, Office of Scientific and Technical Information, U. S. Department of Energy.

INTRODUCTION

An outline is given of present energy R&D cooperation with Japan, the channels that the Department of Energy (DOE) has in place for optimizing the accessibility and useability of energy R&D research results received from abroad, and the amount of information available not only within the Department of Energy but also to the U.S. scientific and industrial community.

ENERGY R&D COOPERATION WITH JAPAN

Japan has had a long standing cooperative program with DOE in various areas of nuclear fission. Breeder cooperation has been particularly active since the 1970's and includes work in nuclear safety, fuels and materials, system plant experiences, physics and other areas. There is also cooperation with the Japanese prototype. The Japanese are participating in the R&D associated with Three Mile Island (TMI), and new activities in the gas cooled, high temperature area are under discussion. Overall, Japan supports about $10 million worth of R&D per year related to nuclear energy in the U.S. through agreements with DOE. A serious effort is currently underway to explore enhanced collaboration in the Breeder area, involving government, vendors and utility organizations.

Japan currently contributes about $11 million annually towards research in the U. S. in fusion and high energy physics through formal cooperative agreements. Under the Working Group on Technology, Growth and Employment of the Economic Summit, DOE is working with Japan and other Summit countries on exploring opportunities for greater cooperation in 18 areas including four related to DOE: High Energy Physics, Fusion, Breeder and Photovoltaics.

Japan participates in 18 of the 34 active International Energy Agency (IEA) R&D agreements. Japan has made available a $10 million superconducting magnet for testing in the U.S. under an IEA Agreement, and has been contributing $2.5 million per year over the past five years to the Hot Dry Rock program at Los Alamos National Laboratory. Under the Nuclear Energy Agency, Japan and the U. S. participate jointly in cooperative arrangements in radioactive waste isolation at the Swedish Stripa mine, through the subseabed disposal working group, in the Loss of Fluid Test Facility at the Idaho National Engineering Laboratory, and in nuclear physics data exchanges and computer codes.

NEED FOR INTERNATIONAL INFORMATION SHARING

Scientific and technical information is one of the primary products of a research and development program. However, an R&D program is not only a producer but also a consumer or user of information. In fact, information serves as a catalyst to increase research productivity. The position of the United States in the world information order has changed dramatically in the last decade. No longer is the U.S. the major developer in virtually all areas of technology. Many countries are now competitive with the U.S. in many fields of technology, so that the U.S. is now a more aggressive gatherer of information abroad. Foreign scientists have always been very much interested in sharing basic research findings, but even more so today as costs of performing research and competition for research funds in all nations increase. It must be noted that the emphasis here is on the sharing of information resulting from basic research rather than information resulting from applied research or research having direct commercial application. However, programs for sharing applied information or proprietary information can and do exist among nations.

DOE TECHNICAL INFORMATION MANAGEMENT PROGRAM

One of the goals of the DOE Technical Information Management Program (TIMP) is to obtain the results of energy R&D investment worldwide to ensure that the DOE, contractor staff, and U.S. industry have the benefit of these advances in energy science and technology. The Energy Data Base (EDB) plays a major role in this endeavor. Created originally to service U.S. DOE funded research programs, EDB stores, in a comprehensive way, records of energy research performed in all of the energy technologies. EDB is available to DOE and contractor organizations via the DOE/RECON information retrieval system and broadly available to the U.S. scientific and industrial community via Lockheed DIALOG and Mead Data Central information services. The cost of maintaining an information system dealing with research results is expensive if one tries to go it alone. Bilateral and multilateral information exchange programs based on reciprocity can help to alleviate these costs.

The Department of Energy (DOE) participates in many international collaborative efforts in energy R&D. To facilitate the exchange of information resulting from these collaborative efforts, the DOE Office of Scientific and Technical Information has developed a program to maximize the accessability and useability of this information within the Department. The Office of Scientific and Technical Information operates under a long-standing policy requiring reciprocity in the international exchange of scientific and technical information. Working in concert with the other DOE Program Offices, particularly the Office of International Affairs

and Energy Emergencies and the DOE General Counsel, the Office of Scientific and Technical Information has developed a standardized Memorandum of Understanding using the policy of reciprocity as the basis for its bilateral information exchange program.

BILATERAL EXCHANGE PROGRAM

These Memoranda of Understanding call for the exchange of summaries of energy-related research and presently exist between the U.S. and the Federal Republic of Germany, the Nordic Consortium (consisting of Norway, Denmark, Finland and Sweden), France, the Netherlands, and the United Kingdom and Northern Ireland. The participants in these agreements acquire and submit summaries of energy-related research as reported in the national literature. The emphasis is on comprehensive coverage of the national literature. These research summaries are exchanged in an international format on magnetic tape and are cataloged, abstracted, indexed, and categorized according to agreed upon standards. In this way, the information is immediately available for machine interrogation and retrieval.

The bilateral agreements also require the transmittal of a full text copy of the report literature. Report literature is sometimes called non-conventional or gray literature, and the hard copy or reproducible fiche is needed to establish availability and for reproduction and distribution. Microfiche of the reports received from the bilateral agreement countries are then distributed throughout the DOE and its contractor organizations and are available to the broader U.S. scientific and industrial community through the National Technical Information Service (NTIS). The energy research summaries are merged into EDB and are available through the retrieval system indicated above.

To ensure the comprehensiveness and currency of information exchanged under these agreements, and to deal with other issues arising, the representatives of the bilateral exchange community have formed a Bilateral Exchange Working Group (BEWG). The BEWG meets twice a year to review operations and discuss matters of common interest pertaining to information exchange.

A bilateral agreement similar to others now in existence is presently being negotiated, and there is agreement in principle for such an exchange agreement. The agreement would be under the auspices of the Japanese Ministry of International Trade and Industry (MITI). Information to be received under this agreement will be available to the DOE and the U.S. scientific and industrial community.

INTERNATIONAL NUCLEAR INFORMATION SYSTEM

The DOE/OSTI also represents the United States as a member of the International Nuclear Information System (INIS) of the International Atomic Energy Agency (IAEA). The INIS program is a multilateral information exchange program whereby the 75 member nations and 15 participating international organizations exchange the nuclear information published within the member countries or issued by the participating international organizations. The information is input in an international format and aggregated by the INIS Secretariat in Vienna. Through the INIS program, the U.S. receives approximately 60,000 summaries representing the nuclear R&D information from participating countries and organizations. Approximately 5,000 items representing the Japanese nuclear literature are included in this total. This nuclear information is also available through NTIS and EDB.

INTERNATIONAL ENERGY AGENCY PROGRAM

The International Energy Agency (IEA) is presently considering the creation of a comprehensive information program. The program would have the same operational features as the DOE/OSTI bilateral information program, including using EDB as the central information resource. The IEA Committee on Energy Research and Development (CRD) and the IEA Secretariat have been exploring possible directions for IEA information programs through an Expert Group on Energy Information Policy created by the Secretariat. The recommendations of the Expert Group were presented at the June CRD meeting, were endorsed by the CRD, and will be noted at the IEA Ministerial Meeting in July. The IEA secretariat will evaluate the user market, develop an estimate of the costs to participants, and draft an information exchange implementing agreement as a starting point for defining the details of operation and management of an IEA comprehensive information program. The Japanese delegates to the CRD meeting positively endorsed the IEA comprehensive information concept. If this program is implemented, it is anticipated that the U.S. will receive the results from several billion dollars of energy R&D expenditure in IEA countries in addition to what is presently being received through OSTI bilateral and INIS programs.

FOREIGN INFORMATION AVAILABLE THROUGH DOE TIMP

As indicated earlier, all information obtained through the TIMP is merged into the EDB for immediate access and interrogation. The EDB presently contains almost 1.5 million energy research summaries of which 54% (780,000 records) represent foreign energy

R&D results. In fact for 1984 the foreign-to-domestic information ratio added to EDB was 3 to 2 or 60%/40%. Representative numbers of energy research summaries received from bilateral agreement countries in 1984 are:

Federal Republic of Germany	17,900
United Kingdom and Northern Ireland	16,200
The Netherlands	10,300
France	4,500
Nordic Consortium	2,200

Also on EDB are over 47,000 summaries of Japanese energy R&D results, mostly representing nuclear information received through INIS. When the bilateral agreement is in place with Japan, this number should be incremented at a rate of over 15,000 energy research summaries per year. This technology will be available not only to the DOE, but its contractor organizations and the U.S. Scientific and Industrial Community through the EDB and NTIS channels.

NATIONAL SCIENCE FOUNDATION
WASHINGTON D.C. 20550

OFFICE OF THE
DIRECTOR

July 3, 1985

Honorable Doug Walgren
Chairman
Subcommittee on Science, Research,
and Technology
Committee on Science and Technology
2321 Rayburn House Office Building
House of Representatives
Washington, D.C. 20515

Dear Mr. Walgren:

Thank you for your letter of June 11 describing your hearings on the role of technical information in U.S. competitiveness with Japan. I appreciate your invitation to testify at these hearings but was unable to appear because of prior commitments. However, for the record, I wish to respond briefly to some questions you raise in your letter concerning NSF's current and future activities that enhance our awareness of Japanese accomplishments and capabilities in key areas of science and technology.

First, as requested by the Science and Technology Committee in its report accompanying the NSF FY 1985 Authorization, I submitted to the Committee a report on U.S. Access to Japanese Scientific and Technical Literature. The report notes that the current attention to Japanese scientific and technical information represents the first serious national discussion of how to follow and utilize foreign R&D since the days of Sputnik, over 25 years ago. It also indicates that significant problems must be confronted to improve our understanding of key trends in Japanese science and technology. These include more perceptive selection of literature worthy of translations, greater attention to non-written communication in Japan, including workshops, conferences, and face-to-face encounters, and more effective policies on the part of individual businesses to facilitate information exchange and technology transfer. The report's recommendations focus on increasing the availability of qualified translators and of individuals who, in addition to their scientific and technical competence, possess sufficient knowledge of Japanese language, policies, and customs to be able to report on any key developments and trends. The report, a copy of which is enclosed for your information, suggests specific actions in support of these general recommendations, and are worthy of your consideration.

The National Science Foundation also has underway several activities of a limited nature that help us access and understand information on Japanese science and technology. NSF has recently assumed sole management of a

project begun jointly with the Department of Commerce two years ago to study select areas of Japanese basic and applied research and examine the implications for American research activities. Two studies, on computer research and on ceramics, have been completed. Studies on opto- and micro-electronics, on biotechnology, and on mechatronics are on going and should be available shortly. And studies on telecommunciations, nonceramic new materials, and on the sixth generation computer will be available in January. This study series will include as well a summary report assessing what we have learned. Based on Office of Science and Technology Policy evaluation of the usefulness of these reports, the project may continue and be extended to cover additional areas of science and technology.

As you are aware, NSF has an office in Toyko, managed by the Division of International Programs within the Directorate for Scientific and International Affairs. The office was established in the early 1960's in accordance with our science and technology agreement with Japan -- our oldest bilateral. The agreement provided for a liaison office to be established by the United States in Tokyo to monitor science and technology activities and to assist NSF grantees in Japan. Three years ago NSF moved to increase the utility of the office, which is housed in the U.S. Embassy, as an information resource. Since then, Tom Owens, who has charge of the office, has produced seventy reports on specific trends and developments. An index of these reports is enclosed for your information.

Finally, the Foundation has recently acted to improve its international data base, and within that, its understanding of Japanese trends. The international data base is being compiled within the Division of Science Resources Studies, and will provide us with valuable information on science and technology trends in other nations. Our ability to assess the situation in Japan specifically, has been enhanced by the addition of staff with competence in the Japanese language and knowledgeable of Japanese institutions, processes, and customs.

I believe that proper understanding and utilization of foreign scientific and technical information is a very significant issue. Measures for enhancing our understanding deserve our serious attention, and should serve as a vital aspect of our policies to maintain U.S. leadership in science and technology.

We would be pleased to discuss these matters further with the Committee.

Sincerely,

Erich Bloch
Director

Enclosures

LIST OF NSF/TOKYO REPORT MEMORANDA

These Report Memoranda were prepared at the request of NSF staff or in order to inform NSF program staff and managers. They deal with ongoing work or developments in Japanese science and engineering, and with Japanese policy for research in science and engineering, primarily for basic research.

RM#	Date	Title
01	08/24/82	Precollege Education in Mathematics, Science and Technology in Japan
02	08/30/82	Electrostatic Precipitation Research (Interview with Prof. S. MASUDA, University of Tokyo)
03	09/07/82	Fluidized Bed Research (Interview with Prof. D. KUNII, University of Tokyo)
04	10/12/82	Japanese Publications re Earthquake Engineering (JOIS Literature Search)
05	11/15/82	Protein Production in Cotyledon Cells (Interview with Prof. N. KAIZUMA, Iwate University)
06	11/17/82	Physical Chemistry of Iron- and Steel-making (Interview with Prof. S. BANYA, Tohoku University)
07	12/07/82	Powder Technology (Interview with Prof. K. MAKINO, Kyoto University)
08	12/14/82	Separation Technology (Interview with Prof. T. WAKAMATSU, Kyoto University)
09	12/16/82	Neurophysiology in Japan (Interview with Prof. Y. KAWAMURA, Osaka University)
10	01/07/83	Precollege Education in Mathematics Science and Technology: Supplementary Information

11	01/19/83	Visit to the Graduate School, Saitama University (Division of Policy Research & Analysis)
12	02/02/83	Company Journals Publishing Research Results of Major Japanese Steelmaking Companies (for Dr. T. Mukherjee, NSF/Washington, D.C.)
13	02/23/83	Separation Technology Visit to Prof. M. SHIRATO, Nagoya University (for Dr. M. Ojalvo, NSF/Washington, D.C.)
14	02/25/83	Separation Technology Visit to Prof. JIMBO, Nagoya University (for Dr. M. Ojalvo, NSF/Washington, D.C.)
15	03/01/83	Japanese University Support Budget for Japanese Fiscal Year 1983: Excerpts & Comments
16	04/04/83	Making Monbusho's Budget for Research Support Programs
17	04/21/83	Polymorphism of DNA and its Relation to the Base Sequence (Visit to Prof. TSUBOI, University of Tokyo)
18	08/02/83	Restructuring of Antibody Genes and Information Transfer in Lymphocyte Differentiation Process (Visit to Prof. HONJO, Osaka University)
19	08/09/83	Mechanisms of Secretory Production of Useful Proteins by Molecular Breeding of Bacillus Subtilis (Visit to Prof. TAMURA, Tokyo University)
20	08/10/83	New Digital Integrated Circuits Using Bridge-type Josephson Junction Devices (Visit to Prof. SUGANO, Tokyo University)
21	09/02/83	Science and Technology Agency Budget (Translation)
22	09/02/83	Neuroscience Facilities at Osaka University: Department of Neurophysiology and Department of Oral Physiology (by Dr. Bruce P. Halpern)

23	09/28/83	Government Support for Small Business Research & Development in Japan
24	10/20/83	Japan's Ministry of Education, Science and Culture: R&D Budget for Japanese Fiscal Year 1983 (April, 1983-March, 1984)
25	10/26/83	University-Industry Cooperation in Japan: Government Guidelines for the Newest Program
26	10/26/83	Japan's Geodesy Council & Its Role in the Making of Science Policy
27	01/23/84	Some Questions and Answers on Japanese Basic Research Capabilities and Plans (requested by Dr. B Bartocha, NSF/Washington, D.C.)
28	10/28/83	FY1983 Awardees of Monbusho's Grants for "Specially Promoted Distinguished Research"
29	01/25/84	Visit to the Japanese Research and Development Association for Future Electron Devices
30	01/31/84	University-Industry Cooperation in Japan: Visit to K. OSHIMA, Vice Chairman, Industrial Research Institute
31	03/07/84	Sociology Research in Japan Requested by Dr. R. Guterback, NSF/SES
32	04/11/84	Kyoto University: Department of Metal Science and Technology Research Institute for Fundamental Physics (prepared by Dr. R. Wasilewski)
33	04/11/84	Publication Histories of Japanese Scientists (report was prepared for NSF/OSTP)
34	05/01/84	Institute of Industrial Science, Tokyo University (prepared by Dr. Roman Wasilewski)
35	05/01/84	University of Tokyo, Department of Materials Science (prepared by Dr. Roman Wasilewski)
36	05/01/84	Tokyo Institute of Technology - Research Institute for Engineering Materials (prepared by Dr. Roman Wasilewski)

37	05/01/84	Osaka University: Welding Research Institute, and Research Center for Ultra-high Density Heat Source (prepared by Dr. Roman Wasilewski)
38	05/15/84	Osaka University: Research Center for Ultra-high Voltage Electron Microscopy (prepared by Dr. Roman Wasilewski)
39	05/15/84	Improving the Scientific Reseasrch System in Japan: Recommendations of Monbusho's Science Council
40	05/21/84	Summary of Monbusho's Budget Related to Basic Research and International Cooperation for Japanese Fical Year 1984 (4/84-3/85)
41	05/23/84	Japan's Space Development Budget for Japanese Fiscal Year 1984 (4/84-3/85)
42	05/25/84	Japanese Budget for Ocean Science and Technology for Japanese Fiscal Year 1984
43	06/13/84	Institute of Scientific and Industrial Research, Osaka University
44	06/13/84	Osaka University, College of Engineering, Department of Metallurgy, College of Engineering, Department of Materials Physics (prepared by Dr. Roman Wasilewski)
45	06/13/84	Tohoku Univ. Department of Metallurgy, Research Institute of Mineral Dressing & Metallurgy, Research Institute of Iron, Steel & Other Metals (prepared by Dr. Roman Wasilewski)
46	06/13/84	Materials Research Underway at Tsukuba University and Other Research Laboratories at Tsukuba, Japan (prepared by Dr. Roman Wasilewski)
47	06/13/84	Materials Research at Hokkaido University (prepared by Dr. Roman Wasilewski)
48	08/06/84	Visit with Dr. K. TOKUMARU, Photochemist, Department of Chemistry, Tsukuba University

49	08/13/84	Visit to Prof. T. TAGAKI, Department of Electronics, Kyoto University
50	08/31/84	FY1984 Awardees of Monbusho's Grants for "Specially Promoted Distinguished Research"
51	11/21/84	Visit to Professor Masanao Toda, Department of Behavioral Science, Hokkaido University, Sapporo: Computer Modelling of Cognitive Systems
52	11/29/84	Basic Research in Japan: Policy in Flux
53	12/12/84	Japan's Science and Technology Agency R&D Budget for JFY 1984
54	12/13/84	Monbusho's R&D Budget for JFY 1984
55	12/13/84	Japan's Ministry of Construction R&D Budget for JFY 1984
56	12/13/84	Japan's Ministry of Posts and Telecommunications R&D Budget for JFY 1984
57	12/13/84	Japan's Ministry of Transport R&D Budget for JFY 1984
58	12/13/84	Japan's Ministry of Health & Welfare R&D Budget for JFY 1984
59	12/14/84	Japan's Environmental Agency R&D Budget for JFY 1984
60	12/14/84	Japan's Ministry of International Trade and Industry R&D Budget for JFY 1984
61	12/18/84	Japan's Ministry of Agriculture, Forestry and Fisheries R&D Budget for JFY 1984
62	12/20/84	Japan's White Paper on Science and Technology for Japanese Fiscal Year 1983
63	01/17/85	1984 Survey of Research and Development in Japan

64	01/28/85	University-Industry Cooperation in Japan: New Policy Gives Universities More Flexibility with Funds from Industry
65	02/13/85	Summary of Japan's White Paper on Science and Technology 1983
66	02/25/85	Visit to Professor Susumu Konishi, Department of Electrical Engineering, Kyushu University: Behavior or Microstructures in Magnetic Domain Walls and Their Application for Ultra High Density Memory Devices
67	02/26/85	Educational Reform in Japan: Some Controversial Recommendations
68	03/01/85	Important Fields of Research for Japan's Future Development
69	03/25/85	Current Programs to Support University/Industry Cooperation in Japan
70	04/05/85	University/Industry Cooperation in Japan: Recommendations of the Japan Techno-Economics Society
71	05/ /85	Prime Minister's Council on Science and Technology Report # 1: Views and Future Program Plans of Science and Technology Mission Agencies

NATIONAL SCIENCE FOUNDATION
WASHINGTON D.C. 20550

April 19, 1985

OFFICE OF THE
DIRECTOR

Honorable Don Fuqua
Chairman
Committee on Science and Technology
House of Representatives
Washington, D.C. 20515

Dear Mr. Chairman:

I have enclosed a report on U.S. access to Japanese scientific and technical literature as requested by the Committee in its report accompanying the NSF FY 1985 Authorization.

As you know, the Subcommittee on Science, Research, and Technology, chaired by Congressman Walgren, has been very actively concerned with this issue. Last March, the Subcommittee held two days of hearings on this matter and asked the Congressional Research Service to perform a follow-up analysis. The CRS submitted a report in October to the Subcommittee discussing the major issues raised at the hearings on the availability of Japanese scientific and technical information and outlining a variety of alternatives and recommendations for action.

The enclosed report further expands on these points. It notes that the current attention to Japanese scientific and technical information represents the first serious national discussion of how to follow and utilize foreign R&D since the days of Sputnik over 25 years ago. I believe this is indeed a very significant issue and that the various recommendations and suggestions contained in both this report and the earlier hearings are worthy of the Committee's consideration. Mr. David Shonyo, Director, NTIS, Office of International Affairs and Mr. George Mu, Director, Office of Japan Affairs, ITA, Department of Commerce both reviewed the report and concluded it provides an accurate picture of the state of U.S. access to Japanese scientific and technical information.

We would be pleased to discuss these matters further with the Committee.

Sincerely yours,

Erich Bloch
Director

Enclosure

cc: Honorable Manuel Lujan, Jr.

51-564 O—85——8

Report to the House Committee on Science and Technology
from the National Science Foundation on U.S. Access to
Japanese Scientific and Technical Literature

I. The Problem in Perspective

Within the last few years, awareness of Japanese accomplishments in science and technology has grown rapidly among American businesspeople, academicians, and government officials. This awareness, in turn, has prompted concern over our country's ability to obtain and use Japanese scientific and technical information (JSTI). Since early 1983, three events in particular have focused on the issue of JSTI availability:

- A workshop held at MIT sponsored by the Department of State and the National Technical Information Service (Gillmor and Samuels 1983);
- The hearings before the House Subcommittee on Science, Research and Technology held last year in March; and,
- A recent (February 7, 8, 1985) conference at the Woodrow Wilson International Center for Scholars entitled "Getting America Ready for Japanese Science and Technology," which focused on language-related issues in JSTI.

Each of these involved some support and/or participation by the National Science Foundation.

Recent attention to JSTI represents the first serious national level discussion of how to follow and utilize foreign R and D since the Russians' Sputnik feat over 25 years ago. Unlike the Russian accomplishments at issue then, however, Japanese developments cover a much broader array of scientific fields and technical specialties, with numerous commercial applications. In addition, since Japanese scientific and technical developments are fueled by that country's robust economy and impressive educational system, we should expect a substantial increase in R and D achievements in Japan over the coming years.

Scanning Capacity

The basic issue addressed in this report is the United States' current ability to obtain and assimilate JSTI. Although part of the focus is on translation of "hard copy" (documents), the search for truly effective solutions would be hampered by a view of JSTI limited to the translation and distribution of written materials. Americans must also have the requisite knowledge to identify the written materials in Japanese most worthy of the translation investments of money and time. As one participant at the recent Wilson Center conference (Barbara J. Peterson, 3M, Minnesota) observed, some American corporations have spent considerable amounts for translation, only to reap marginal results because they had not selected the most important materials. Researchers in the United States need to become more familiar with the structure of R and D in Japan and with Japanese modes of scientific and technical communication and reporting, in order to screen materials effectively, particularly since the quality of the literature varies widely (Westney 1984; Hane et al 1984). Knowledge of the "invisible college" of personal networks is even more critical to following current research in Japan than it is in the United States (Westney 1984; Togasaki 1983).

Another important consideration is the role of communication in forms other than written materials. Participants at the 1983 MIT workshop repeatedly emphasized the value of face-to-face encounters with Japanese researchers (Gillmore and Samuels 1983). Others as well have recognized the value of visits to Japanese research facilities and conferences in Japan (Hane et al. 1984). The Japanese themselves participate extensively in overseas conferences, site visits and collaborative research projects; their use of written information makes these activities more effective, and their person-to-person activities result in more effective written information.

Finally, scientific information should be distinguished from technological information. Studies show that the policies of industrial organizations towards the transfer of technological information may be more important in influencing their involvement in information exchanges than the design of the information system (Ganz 1978).

Sources in English

The question has been raised of whether there actually is a need for more information from Japan, particularly since some sources already in English appear underutilized (Bloom 1984). Research conducted by NTIS, including a survey of some 500 VP's for research in U.S. companies, indicates an unmet need for JSTI translations (Shonyo 1984); Herman Baron, Director of the newly formed Japan Technical Information Service, (JTIS) stated at the Wilson Center conference that his company conducted a "major market study" for Xerox Corporation before the latter committed itself to capitalizing the new enterprise. The 1984 Department of Energy evaluation of energy conservation research in Japan found fair or poor quality of technical information transfer to the United States in five out of the ten research fields studied (Hane et al.). In a 1982 survey of faculty at North Carolina State University, over a third of the respondents claimed an interest in Japanese developments in their field, but reported a lack of channels to make use of them; evaluations of Japanese research efforts were highest among science and engineering faculty (Coleman 1983; 1984). When the American Electronics Association (AEA) surveyed member companies with operations in Japan on Japanese language skill needs, over half of the 34 corporations responding claimed a need on an occasional basis or more often, according to the AEA's Pat Hill Hubbard in her presentation before the Wilson Center conference.

Regarding underutilized sources in English, a number of experts question the quality of the English language materials currently available when compared with the literature in Japanese. In their study of information flow on Japanese research related to energy conservation, a Battelle task force found the literature in Japanese to be: 1) more timely; 2) often more detailed, describing experimental details frequently omitted from the international literature; 3) of additional value to the international literature, rather than redundant; 4) more comprehensive than the international literature, since many individual Japanese researchers publish principally or solely in Japanese; and 5) more informative concerning applications and industrial research, whereas the international literature is principally academic (Hane et al. 1984). Similarly, a study

involving over 100 interviews with specialists in technology-intensive industries, conducted by an independent research institute called the Global Competitiveness Council found JSTI in English to be dated and overly general when compared to materials published in Japanese (Rubinger and Yoshizaki 1984). Within the academic literature, the Japanese tend--for understandable reasons--to put only their finest research results into English for international presentation; the layer of research immediately beneath that level also contains valuable information.

II. Analysis of U.S. Capabilities in JSTI Translation

This report outlines a comprehensive view of U.S. capabilities in JSTI that places translation activities in the larger context of JSTI monitoring and assimilation.

Federal Agency and Private Sector Translator Staffing Needs

The central source of scientific and technical information resulting from research undertaken by and for the U.S. government is the National Technical Information Service (NTIS), located within the U.S. Department of Commerce. The NTIS collection is available to the public, but NTIS places a charge on reports to cover their operating costs, since NTIS is legally required to be self-supporting.

In 1981, NTIS began the Foreign Technology Acquisition Program to acquire foreign scientific and technical reports. NTIS relies upon a Japanese organization, Mitsubishi Research Institute, to identify sources of relevant technical reports and to procure them. The potential access to Japanese technical reports is growing; to date, acquisition arrangements have been completed with 43 Japanese research organizations, among them the Agency of Industrial Science and Technology, Matsushita Electric Industrial Company, NEC Corporation, and the University of Tokyo Faculty of Engineering. The Foreign Technology Acquisition Program was initiated with an appropriation of $750,000 in FY81, but appropriations were decreased by $250,000 in each of the subsequent fiscal years (Shonyo 1984).

The actual number of documents that the Foreign Technology Acquisition Program can process is restricted by language-related problems. Reports left in the original Japanese have almost never been sold out of the NTIS data base, even though they have English abstracts and titles. Japanese language materials cost more to translate than do those in European languages, and NTIS has experienced difficulty in finding qualified translators (Shonyo 1984).

The Foreign Broadcast Information Service (FBIS), an arm of the Central Intelligence Agency, monitors foreign media and transmits those articles it deems significant to the Joint Publications Research Service (JPRS), an FBIS organization which employs some 1,000 independent contractors (Miller 1984). In 1983, FBIS began publishing Japan Report: Science and Technology, which is dedicated to JSTI. The JPRS selects articles from approximately 250 Japanese publications for Japan Report; the volume of material published by late 1984 came to 6,000 pages annually (Miller 1984).

The National Science Foundation recently has expanded the reporting capabilities of its Tokyo office on Japanese basic research activities and priorities. These reports have been highly useful, but at present they do not reach a large audience.

Within the U.S. military, the Office of Naval Research (ONR) operates a field office in Tokyo which monitors activities in most of the fundamental scientific disciplines. The Tokyo office publishes a quarterly periodical entitled Scientific Bulletin: Department of the Navy Office of Naval Research Far East. The Army also staffs an overseas office that monitors scientific and technical developments in Japan, the Science and Technology Center, Far East Operations (STCFEO). Most of the data gathered by the military are not available to the private sector; the ONR has publicly stated that it is not responsible for keeping U.S. commercial interests informed (Businessweek, February 13, 1984).

According to reports and statements presented to Congress, the Foreign Broadcast Information Service has also experienced the difficulty reported

by NTIS of finding qualified translators (Miller 1984). Although NTIS often relies on the JPRS for translation work, the latter has not had the capacity for handling NTIS requests for translating work from Japanese (Shonyo 1984).

To date there are no systematic studies of the current capabilities of private technical translation agencies. Such research is needed to assess the private sector's ability to meet academic and industry needs as well as those of the government, although Federal agencies rely the most heavily on contractors for translation of JSTI.

The available translation skills and knowledge in the private sector are difficult to measure, in part because there are no reliable data on the qualifications of the translators hired, and in part because of the lack of an accurate way of counting the numbers of translators available at any one time to one agency; commercial operations may overstate the expertise at hand, and their relationships with translators are very fluid, with many translators affiliating with more than one agency.

Available indications suggest an inadequate number of qualified translators. Technical Japanese Translation, the only newsletter that provided a professional forum for American specialists in the translation of JSTI and attempted to increase public recognition of the importance of their role, had a circulation of about 200 world-wide by November of 1984 when it ceased publication with its 21st edition. (It began in early 1983). In the last edition, a directory of individual translators and agencies listed only 28 entries in the United States. During his presentation at the recent Wilson Center conference, Larry Brouhard, President of International Communication Service (a Tokyo-based technical translation company that recruits in the U.S.) reported a lack of native speakers of English who have Japanese translation abilities plus a grasp of technical concepts.

Translation talent flows mostly to large multinational corporations. During the Congressional hearings, Professor Eleanor Westney of MIT's Sloan School of Management made the following point:

> The large-scale global corporations will be able to monitor Japanese science and technology, but that will not be passed on to the rest of American industry...the medium-scale and smaller scale companies that have been, in many cases, the driving force behind America's technological development, will be at comparative disadvantage (Westney 1984).

As illustration of efforts underway among large corporations, V. J. Fortney, Head of the AT&T Bell Labs Information Services Department, describes the current Bell Labs program:

> To improve access to important Japanese technical publications for AT&T Bell Labs scientists and engineers, we have begun an accelerated program with the following objectives: (1) monitor, identify, and quickly scan and translate new key Japanese papers in specific technologies, (2) announce these to interested technical staff, (3) improve the ability of our library network staff to acquire and catalog key Japanese conferences and publications, and (4) establish important contacts with professional and scientific organizations and information centers in Japan (Fortney 1984).

Domestic Production of Expertise for Greater Self-Sufficiency

Our country's ability to identify and use Japanese published materials effectively depends on a familiarity with Japanese information channels as well as on Japanese language expertise. Another important factor is "interdisciplinary skills--technical, economic, international business, public policy, competitive analysis" required for interpreting data in a larger context beyond the scope of individual researchers and firms (Rubinger and Yoshizaka 1984). A number of expert witnesses at the Congressional hearings (Alic, Bartholomew, Coleman, and Westney) advocated providing Japanese language and area studies programs at American universities geared to building a cadre of technically sophisticated U.S. citizens with professional competence in the Japanese language. Similarly, the 1984 background paper prepared for the United States-Japan Advisory Commission, entitled Stabilization and Expansion of Long-Term Scientific and Technical Cooperation Between the United States and Japan, recommended

providing Japanese language training opportunities for American scientists and engineers (Bloom and Yakushiji 1984).

The following data suggest that current college and university programs are inadequate. Despite a dramatic increase of 40 percent in Japanese language enrollments in American colleges and universities between 1980 and 1983, students taking Japanese courses numbered only about 16,100 nationwide in 1983--fewer than two percent of total language enrollments (calculated from Brod 1985). On the basis of their survey sampling the major East Asian Centers at American universities, Coleman and Samuels (1985) offered the "educated guess" that no more than 400 students of science and engineering in the U.S. are currently studying Japanese. This figure represents less than two-tenths of one percent of all science and engineering degree recipients yearly at U.S. universities and colleges. In addition, Coleman and Samuels also pointed out that the great majority of these students are taking introductory level courses and do not represent professional users of the language. Only one U.S. university, the University of Wisconsin, offers a course in technical Japanese. The course, first offered in 1981, has so far had twelve students. (Coleman and Samuels 1985).

Debate persists concerning the extent to which the American corporate community is inclined to make full use of American science and engineering graduates with Japanese expertise. Two university programs that provide internships in Japan at corporate laboratories, one at MIT and one at North Carolina State University, have more requests for interns than qualified applicants. The AEA's internship program in Japan, which began last year with six graduate students, will continue this year. Nevertheless, the consensus at the Wilson Center conference appeared to be that corporations are not yet systematically recruiting and structuring careers for those American graduates of science and engineering programs who also offer Japanese expertise. According to Pat Hill Hubbard, AEA member companies with operations in Japan typically hire from among the Japanese to meet their informational needs; in fact, she said, respondents to the AEA survey appeared more concerned about getting English training for their Japanese employees than the reverse.

Significance of Machine Translation Efforts

Translation of technical material from Japanese into English is less complex than literary translation, which makes machine translation an attractive supplement. All of the expert participants at the Wilson Center conference agreed, however, that at no point will machine translation completely substitute for human expertise; the computer, rather, should be regarded as an enhancement to the individual translator's efficiency. Systems that will soon be commercially available produce documents that require considerable post-editing by a human. Nor, of course, can machine translation efforts solve the problem of scanning capacity.

Much of the initiative in Japanese-to-English machine translation projects has been assumed by the Japanese themselves. The current Japanese drive can be understood in large part as an extension of Japan's export efforts in high-technology products, which require extensive documentation in the user's language (Nagao 1985).

III. Improving the Federal Role in the Translation and Dissemination of Published JSTI

Since the problems of JSTI availability are multifaceted, so must the solutions be. This section puts forth recommendations of a short-term high-priority nature.

A Comparative Analysis of Governmental Roles in STI

Following an expert opinion given in the Congressional hearings by MIT's Westney (1984), useful guidelines for a Federal role would benefit from further study of the processes of JSTI gathering and dissemination in the U.S. and in Japan. Recently completed research compares scientific and technical information seeking patterns of Japanese and U.S. engineers in the context of the R&D process (Gerstenfeld 1980; Gerstenfeld and Berger 1980). One point well acknowledged in all the recent discussions concerning JSTI is Japan's ability to coordinate information-getting and

apply what is learned. The United States need not necessarily duplicate Japanese structures and processes, but analysis of Japanese successes--and failures--may point the way to more effective measures for the U.S.

A comparative study could also generate strategies for better coordination of Federal JSTI activities. The 1983 MIT workshop made a case for the need for coordination. In addition, Hane et al. (1984) suggests that there be a study that would consider ways to improve government efforts to monitor foreign patents. Another study possibility would be to attempt to estimate the extent to which the American public and private sectors currently rely on the Japanese themselves for the gathering of JSTI.

Re-examination of the U.S. Government Procurement System

A key issue in the shortage of translators available for Federal government work is their level of remuneration. One option might be for the government to critically re-assess its competitive bidding system for translations. David Shonyo (Director of NTIS' Office of International Affairs) observed that the current system allows translators with marginal qualifications to submit low bids accepted by contracts officers; such contractors cannot be rejected until they prove themselves unqualified. The procurement process must then begin anew (quoted in Philippi 1984a). In addition, Larry D. Brouhard noted at the Wilson Center conference that procurement agencies still bid too low. According to Donald Philippi, a prominent technical translator, "There is a widespread perception among technical translators in the U.S. that their biggest enemy is the U.S. government" due to its competitive bidding practices (1984a).

Another topic for future investigation is the applicability of Japan's own certification efforts for technical translators through that country's National Translation Institute of Science and Technology (NATIST). NATIST standards provide for four grades of competence; the NATIST College offers modified correspondence courses in technical writing for five technical topic areas (Koretsune 1985). The American Translation Association is now investigating the issue of accreditation for J-E translators.

Copyright Issues

As noted in Congressional testimony, Japanese copyright law poses a restraint to the dissemination of government-funded translations (Shonyo 1984; Braegelman 1984; see also Miller 1984). These laws are complex and often require time-consuming approval chains through individual authors and their funding organizations to get releases. For CIA-funded publication through the Joint Publications Research Service, unrestricted public distribution is sometimes hindered by the dictates of Japanese copyright, not national security. The NTIS has, since 1980, established the previously mentioned agreements with over 40 Japanese research organizations to help overcome these problems. Agreements with Japanese private concerns such as those made by JTIS may offer another model. While copyright may at times remain a barrier, these agreements and changing Japanese attitudes in favor of quid pro quo arrangements for document exchange appear to be lessening the problem.

IV. Options for Reducing Barriers to JSTI Availability

In addition to the research activity and administrative reform suggested above, the Federal government has an important role to play in program development.

Programs to Develop JSTI-Related Expertise

A number of witnesses at the Congressional hearings emphasized the importance of Federally-supported programs to encourage Japanese language study among students in science and engineering (see Miller 1984 for a summary). Federally-funded scholarships and fellowships for such students on the order of the National Defense Foreign Lanuage program of the 1960s and 1970s comprise one possible model. MIT's Westney, representing the first and most sophisticated comprehensive university-based Japanese science and technology program, stated at the Congressional hearings that a revitalization of the NDFL program would "represent a long-term investment

in the national interest that only the federal government is in a position to make" (Westney 1984).

More fellowships for research in Japan and postdoctoral awards for visits to Japan should also be considered. Longer-term scientific visits to Japan contingent upon previous Japanese language study is one mode. In addition, the Japanese research experience would provide knowledge of the Japanese R and D process as well as valuable contacts among Japanese colleagues that would serve younger American participants throughout their careers (Coleman and Samuels 1985). The new, but small, NSF program of postdoctoral fellowships, which encourages language training prior to research activity in OECD countries, is a step in this direction. Other programs are needed, however, to channel capable students in science and engineering at an earlier point in their careers, since professional competence in Japanese requires several years of language study (Coleman 1984b).

The Battelle report on Japanese energy conservation research (Hane et. al. 1984) identifies the benefits of such visits over simply relying on Japanese visits to the U.S.: 1) visits allow detailed exchange about work underway at the Japanese facility; 2) examination of the facilities provides indications of the approaches and limitations of experiments in Japan, which are not always available in the literature; and 3) visits allow interaction with Japanese researchers who do not travel frequently to the U.S. In FY 1984, over 250 American scientists and engineers made research visits to Japan under the U.S.-Japan Cooperative Science Program supported through the NSF. The benefits of this program include access to expertise in Japan and the techniques and data of collaborating scientists.

The Japanese are currently developing programs for long-term visits and collaborative research in Japan for accomplished foreign researchers. Of particular note is the "Japan Trust" proposed by the Ministry of International Trade and Industry for its research facilities (Nihon Keizai Shimbun 1984). Also of interest are compilations of information and advice among American scientists concerning their experiences in long-term

exchanges in Japan. One recent example is a handbook, Informal Handbook for Long-Term Exchanges in U.S.-Japan Cooperation Program in Fusion Research, prepared under Department of Energy auspices (U.S. Department of Energy 1983). Circulation of such information among government agencies would augment the value of long-term research activities in Japan.

Efforts to Expand the Use of JSTI

Only some of American industry is well acquainted with the techniques required to enable ready assimilation of JSTI. Although, as mentioned above, a number of large multinational corporations are taking steps to acquire JSTI, small and medium-sized firms that also face stiff import competition and/or provide important technological innovations may be at a severe disadvantage, and could benefit from improved access to JSTI.

NSF cooperative programs at universities that involve industry participation offer some opportunity for the application of JSTI to industrial processes. With further funding for adequate execution, these programs could "internationalize" and add a JSTI component that uses university expertise for scanning, and the university extension services for dissemination.

A recently proposed program deserves attention as a possible model for involving university extension services in the acquisition and dissemination of JSTI. The North Carolina Japan Center, in cooperation with the North Carolina Science and Technology Research Center, has described a possible program of JSTI translation and distribution that would involve North Carolina State University extension services in the School of Textiles, Engineering, and Agriculture and Life Sciences, for the region's textile, furniture, food processing and pulp and paper industries. The impetus for this effort came from requests for proposals announced by the National Technical Assistance Program, under the U.S. Department of Commerce Economic Development Administration.

Such efforts, along with existing cooperation programs, suggest a possible role for the federal government to facilitate state government and

private industry activities at those universities having vigorous industrial and agricultural outreach programs as well as Japanese language and area studies programs--particularly if these universities design Japan-related course offerings geared to the specific needs of students in science and engineering.

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April 2, 1985

Hon. Doug Walgren
U.S. House of Representatives
Subcommittee on Science, Research
and Technology
2319 Rayburn HOB
Washington, D.C. 20515

To the Honorable Doug Walgren:

Recognizing your interest in international developments in science and technology, I am writing to alert you to a study of the technical strengths of research and development in Japan and technical information flow from Japan to the U.S. This study reviewed ten energy conservation-related technology areas and was principally based on interviews with researchers in the U.S. who are familiar with work in Japan. I have enclosed a copy of the executive summary for your information.

Researchers noted the increasing advancement of applied research, and more significantly, noted the shift in emphasis to longer-term fundamental research in Japan. In several technology areas it was felt that the quality and sophistication of research was at a par with that in the United States. Furthermore, the R&D "momentum" in these and other areas is expected to result in significant technical advancement in Japan. It was also noted that the excellent capability in manufacturing processes that already exists in Japan provides a greater ability to commercialize new technologies and amplifies the technology challenge to the United States.

In the area of technical information transfer, most researchers relied on personal contacts in Japan as their primary sources of information. Although researchers in Japan also publish in international English language journals and attend international conferences, there was a strong sense that this only represented a portion of the significant work under way, and that the information was dated. In only one of the fields reviewed, heat transfer, was there a service that screened and translated articles published in Japan.

This study was the first step in a continuing effort to monitor research and development internationally. We have also completed a more detailed analysis of Japanese research in amorphous metals, and are initiating studies in several other research and technology areas.

If you have any questions about the enclosed study or about our program, please feel free to call me at 617/864-7199 or Jack Eisenhauer at 202/785-8400.

Sincerely,

Gerald Hane

Gerald Hane
Research Engineer
Technology Planning and Analysis

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Assessment of Technical Strengths and Information Flow of Energy Conservation Research in Japan

Volume 1 — Executive Summary

G. J. Hane
P. M. Lewis
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September 1984

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ASSESSMENT OF TECHNICAL STRENGTHS AND INFORMATION FLOW OF ENERGY CONSERVATION RESEARCH IN JAPAN

Volume 1 - Executive Summary

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September 1984

Prepared for
the U.S. Department of Energy
under Contract DE-AC06 76RLO 1830

Pacific Northwest Laboratory
Richland, Washington 99352

(a) Global Competitiveness Council

PREFACE

This study was completed for the Office of Energy Systems Research (ESR) in the Department of Energy. The primary goal of ESR research programs is to provide a solid technology base in areas related to energy storage, energy conversion, energy end use, and the transmission and distribution of electrical energy. These programs serve as the foundation for the energy end-use offices in the DOE Conservation and Renewable Energy Program as well as for those in private industry. The specific objectives of ESR are:

1. to develop the technology base required to achieve improvements in the efficiency and fuel flexibility of future energy conversion, storage, transmission, distribution, and utilization in all end-use sectors.
2. to improve the energy efficiency of technologies having application in a variety of industries.
4. to provide technology options that will enhance the reliability of the nation's future electric network under normal and emergency situations.

To aid in achieving these objectives, in 1981 the ESR staff established the Technology Analysis and Evaluation Project, which is conducted from the Pacific Northwest Laboratory.(a) This project assists ESR in planning and managing its research program by conducting technical program evaluations, program information management, technology characterization and assessments, and international technology monitoring.

This document is a concise report of a study performed to build the groundwork for ESR international monitoring efforts. The study explores the status of research and technology developments in Japan and the ability of U.S. researchers to keep abreast of Japanese technical advances. Ten technology areas that can be applied to improving the efficiency of energy use and that

(a) Pacific Northwest Laboratory (PNL) is operated for the Department of Energy by Battelle Memorial Institute.

are relevant to ESR research programs were examined. The details of this investigation are published in a supporting document.(a)

(a) Hane, et al. 1984. Assessment of Technical Strengths and Information Flow of Energy Conservation Research in Japan: Background Document. PNL-5244, Vol. 2, Pacific Northwest Laboratory, Richland, Washington

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EXECUTIVE SUMMARY

The history of technology development in Japan is marked by a remarkable effectiveness in combining national expertise with international developments and research results. Japan's significant advances in technology have caused concerns about the ability of the U.S. technical community to keep abreast of these activities. Problems of language, culture, and physical distance have aggravated the lack of U.S. understanding and made this deficiency in our ability to monitor Japanese R&D increasingly apparent. These concerns have been recognized by many groups, including the U.S. Congress, which held a subcommittee hearing on this topic in March 1984.(a)

These concerns have become increasingly important as the levels of research activity in Japan continue to rise. In 1970 the investment in R&D in Japan as a fraction of the gross national product (GNP) was ~1.8%, compared with 2.6% in the U.S. By 1981 the Japanese commitment to R&D had increased to ~2.4%, approximately equaling the U.S. percentage. Total R&D spending as a percent of GNP over the years 1970 to 1983 is shown in Figure 1 for Japan, U.S., West Germany, Britain, and France. Because of the increasingly specialized nature of defense and space R&D, excluding R&D spending for these areas provides a more direct measure of efforts relevant to economic growth and social goals. The ratio of this nondefense, nonspace R&D to GNP is shown in Figure 2. This figure shows that Japan has significantly outpaced the U.S. since the late 1960s, having a ratio of 2.2% in 1981 compared with 1.7% in the U.S.

Through the perceptions of U.S. researchers, this study evaluates the researchers' strengths and comparative status of Japanese work in their respective fields, as well as their perceptions of the quality of information transfer to the U.S. technical community. Researchers were identified and interviewed in ten technology areas:

- Amorphous Metals
- Biotechnology

(a) House Committee on Science and Technology, Subcommittee on Science, Research and Technology, March 6 and 7, 1984.

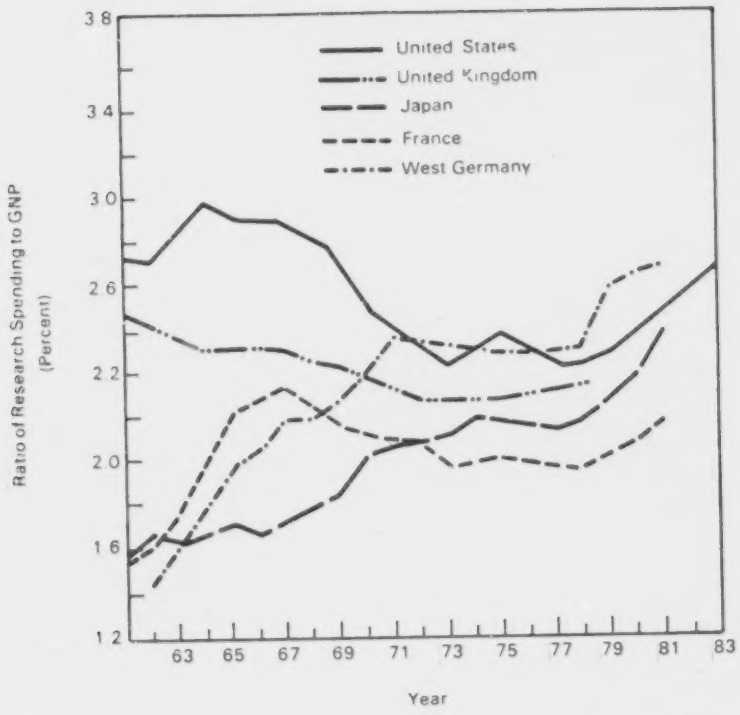

FIGURE 1. Ratio of Total National Research Investment to GNP (National Science Foundation. 1983. Science Indicators - 1982. National Science Foundation, Washington, D.C.)

- Ceramics
- Combustion
- Electrochemical Energy Storage
- Heat Engines
- High-Temperature Sensors
- Heat Transfer
- Thermal and Chemical Energy Storage
- Tribology.

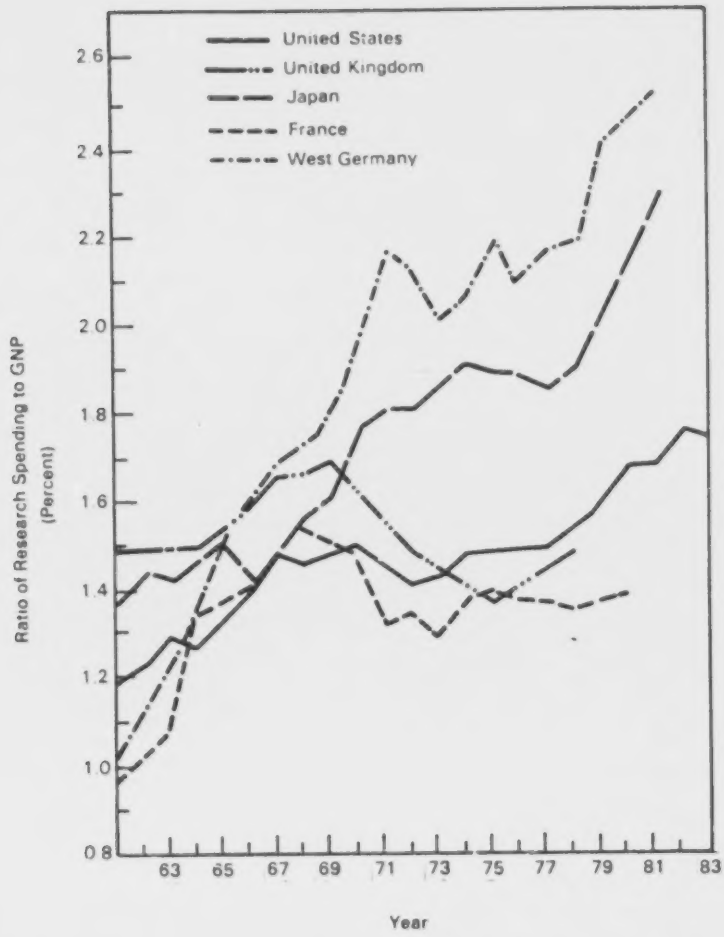

FIGURE 2. Ratio of Research Investment (Excluding Defense and Space Research) to GNP (National Science Foundation. 1983. Science Indicators - 1982. National Science Foundation, Washington, D.C.)

These technology areas were selected because they generally can be applied in promoting the more efficient use of energy and because they are relevant to programs within the Office of Energy Systems Research in the U.S. Department of

Energy (DOE), which supported this effort. Of particular interest in the study was the longer-term, basic and applied research. Basic research typically involves investigating the fundamental behavior of processes, and applied research typically addresses particular applications or technologies and improvements in their performance.

This study is therefore intended to provide a preliminary indication of the status of important technical research in Japan and the ability of researchers to follow these areas. Although the researchers' perceptions are generally qualitative, they nonetheless provide technically-based assessments of overseas technical progress at the earliest stages of development. Their comments on the quality of information transfer provide indications of the ability of U.S. researchers to benefit from research results and developments in Japan, as well as the ability of U.S. research managers to develop their plans with an international perspective.

GENERAL PERCEPTIONS OF THE STATUS OF JAPANESE RESEARCH

Analyzing the comments offered by researchers in the various fields reveals several consistent observations about research in these areas in Japan.

A summation of researchers' estimates of the comparative status of research in Japan is provided in Table 1. The columns in the table describe the status of the basic and applied research efforts, as well as changes in programmatic emphasis toward more basic research and the "momentum" of the basic or applied research effort. The perceptions of the status of the basic and applied research efforts are rated in the table as either very strong, strong, moderate, or weak.

"Very strong" work is generally excellent and at the leading edge of the technology, with significant aspects perceived as superior to the U.S. "Strong" work is of high quality and generally comparable to work in the U.S. "Moderate" work is good but still apparently several years behind U.S. efforts. "Weak" work is not very significant, with the U.S. having a far greater research capability.

The table shows that significant technological challenges to the U.S. are perceived in the areas of amorphous metals, biotechnology, and ceramics. Also,

TABLE 1. General Perceptions of the Status of Basic and Applied Research in Japan

Research Fields	Researchers Interviewed	Basic Research			Applied Research	
		Status	(Momentum)	(Recent Emphasis)	Status	(Momentum)
Amorphous Metals	11	***	(0)	(+)	****	(+)
Ceramics	16	***	(0)	(0)	****	(+)
Combustion	15	***	(+)	(+)	***	(+)
Tribology	13	***	(+)	(+)	***	(0)
Heat Transfer	7	***	(0)	(0)	***	(+)
Biotechnology	6	**	(0)	(0)	****	(+)
Heat Engines	10	**	(0)	(0)	***	(+)
Electrochemical Energy Storage	9	**	(0)	(0)	***	(+)
Thermal and Chemical Energy Storage	6	*	NA	NA	**	(+)
High Temperature Sensors	8	NA	NA	NA	**	(NA)

Symbols

**** very strong
*** strong
** moderate
* weak

+ positive emphasis
0 no significant emphasis
- activity decrease
NA information not available

significant R&D momentum was noted in the area of stationary Stirling engine development. The researchers' observations on the strengths of research in Japan are summarized in the technology-specific discussions below.

Amorphous Metals

This study focused on research addressing the magnetic properties of amorphous metals. Although opinions were somewhat mixed, most researchers noted that fundamental work in the U.S. currently appears to be superior to research in Japan in both the extent of high quality research and the work of the top individuals. In particular, the work of Egami and Graham at the University of Pennsylvania is noted for its excellence.

The Japanese effort in amorphous metals was noted for its strength in the applied development of the materials and production techniques for a wide range of applications. Several researchers noted that researchers in Japan will test hundreds of materials to find those with the desired characteristics or to derive rules empirically. The materials development is then applied to a wide range of end uses. Currently the areas receiving the greatest amount of attention are power transformers and consumer electronics. The first major government-supported amorphous alloy program is a five-year effort that began in 1981 to develop power transformer cores. In addition to the development of power transformers, electronics firms are exploiting the unique magnetic properties of these materials and have already produced the first magnetic recording heads manufactured by a double-roller quenching technique. This technique results in recording heads with performance characteristics that are superior to those previously available.

However, just as significant as the applied work supported by the government is the very recent emphasis on long-term R&D. A three-year, government-supported program to establish a fundamental research base was completed in 1983. Additional research that will be performed by private and public organizations is currently being coordinated by the government, although the details are not publicly available.

Biotechnology

Biotechnology is being targeted by the Japanese government as one of the major high-technology industries of the future. As a result, there is a great deal of interest and activity in this area within the Japanese research community. As with the development of most other new technologies in Japan, the emphasis of the initial activity is on the applied development of this science. In the fundamental sciences of microbiology and genetic engineering, the consensus among the researchers interviewed is that the U.S. clearly has a superior research capability. However, Japanese industry has applied biotechnology on an industrial scale (in the form of fermentation technology) for example, and has gained extensive process engineering experience. In a recent study of international biotechnology development, the Office of Technology Assessment noted that the Japanese government spends a large portion of its $60 million for biotechnology on processing aspects, while as little as $6.5 million of the billion dollar U.S. budget is spent on industrial processing techniques. Given the Japanese capability, history, and governmental focus on bioprocess engineering, the U.S. most likely will be severely challenged in this technology in the near future.

Ceramics

Ceramics has also been targeted by the Japanese government as one of the high-technology industries of the future. The R&D emphasis again appears to be on the applied development of the technology, processing techniques, and a wide variety of end uses. In material characterization research, the general consensus is that Japan and the U.S. are at a rough parity. It was also noted, however, that there is a substantial amount of momentum in Japan. For example, several researchers noted that for every one researcher working on a technical problem in the U.S., there are frequently five to ten working on the same problem in Japan.

The main thrust of the Japanese effort, however, is perceived to be toward expanding the applications of ceramics and developing processing techniques. There is a strong consensus that Japan has already surpassed the U.S. in both aspects by producing materials with greater uniformity and reliability and by integrating computer controls more extensively in their processing.

Combustion

The general consensus among the combustion researchers interviewed is that Japan's efforts focus far more on applied areas than the U.S. efforts. Researchers note that the basic combustion research work in the U.S. is much more broadly based and at the leading edge of the science. However, it was felt that combustion activity in general was increasing in Japan and that the momentum currently building is likely to create a substantial challenge to the U.S. in the future. Research in Japan was noted to excel in the applied aspects; particularly noted were the efforts underway in adiabatic diesel engine combustion and coal combustion. Also, Japanese work is perceived to be superior in the use of instrumentation and microprocessor controls for combustion.

Electrochemical Energy Storage

Assessing the overall field of electrochemical energy storage is hampered by the wide variety of electrochemical systems. The Ministry of International Trade and Industry (MITI) is currently in the fourth year of an 11-year program to develop electrochemical energy storage technology for utility load leveling. The batteries being studied are sodium-sulfur, zinc-chloride, zinc-bromine, and redox types. Comments offered indicate that the work in Japan is somewhat behind that of the U.S. However, the significance of this national program should not be ignored because other national efforts often have resulted in the state-of-the-art balance tilting in Japan's favor. Other battery technologies identified in which Japanese development is superior include manganese-dioxide, lithium-magnesium, and lithium-CFx batteries. These technologies are less well publicized because they are not part of the MITI program.

Heat Engines

Unlike most of the other technologies covered in this study, researchers noted that much of the technical research published in Japan concerning the Stirling engine is fundamental, rather than applied. While the work is expected to contribute to a substantial data base, researchers could not identify areas in which this would create a technical disadvantage for the U.S. However, although details are sparse, significant work is generally thought to

be underway in the applied development of this technology. For example, the six-year, $44.4 million MITI-sponsored project to develop a residential/commercial size heat pump is considered to be significant. In gas turbine development, an MITI-sponsored project in combined-cycle technology was also noted, as well as the development of low emissions technology that is considered superior to U.S. technology. Overall, however, researchers indicated that the U.S. has an edge in Stirling engine and gas turbine development.

Heat Transfer

There was an unusually high level of agreement among the researchers in this field on the strengths and comparative development of the work in Japan. In the fundamental study of heat transfer the efforts in the two countries are perceived to be comparable, with a slightly broader effort in the U.S. The strength of the work in Japan is considered to be in the applied areas, with particularly notable work in enhanced surfaces, boiling, condensation, high temperatures, and heat transfer in electronic components. Products of these technologies have already been demonstrated to be superior to those offered elsewhere. This is clearly considered an important technology area in Japan and again one in which significant advances are occurring in the applied development areas.

High-Temperature Sensors

A definite lack of comprehensive information hampered the assessment of Japanese efforts in high-temperature sensors. No comments were offered on the fundamental research aspects. Researchers did comment that the ability to apply the sensors appears to be superior in Japan. Again, it is in the process-related characteristics that Japanese work is particularly notable. In the more applied aspects, increasing Japanese interest was noted in fiber optic high-temperature sensor technology, but the U.S. is still considered to lead in this area.

Thermal and Chemical Energy Storage

Assessments of the thermal and chemical energy storage field were also severely hampered by a lack of available information. Researchers noted that before the late 1970s Japan did not appear to have much interest in this field.

However, lately researchers have sensed a rapid increase in activity but find that activity difficult to define. Areas in which research effort is apparently being accelerated include phase-change technology, clathrates for low-temperature energy storage, and metal hydrides. In each of these areas there is some feeling that technology in Japan is comparable to and is even surpassing development in the U.S.

Tribology

Perceptions of Japanese efforts in tribology were the most marked by the significant variation in opinions offered. One group of researchers felt that the work in Japan still generally lags behind that of the U.S., while a second group claimed that the program in Japan has greater depth and scope and is shifting toward a greater emphasis on fundamental studies. This possible shift is evidenced by the tribology facility newly opened at Japan's National Mechanical Engineering Laboratory. Researchers who noted the strength of the Japanese effort pointed to several contributing characteristics, including a stronger capability in the analysis of the chemical component of tribology, less division of research along academic disciplines, and a greater depth in the secondary and tertiary university research facilities.

Overall Analysis of Researcher Perceptions

From the comments offered by researchers in the various fields surveyed, a number of common perceptions about R&D in Japan were identified. These include observations regarding the Japanese emphasis upon applied rather than basic research, the occasionally greater degree of cross-training in Japan, the greater use of empirically-based R&D approaches, the coordination among researching organizations, and the longer-term commitment to research. These observations are discussed below.

Researchers noted almost unanimously that the strength of the Japanese effort is in applied research rather than basic work. Researchers in several fields noted that efforts in Japan have often relied on results from basic research performed elsewhere, although it was observed by several researchers that the Japanese will repeat another nation's work to establish their own data base. These observations seem consistent with the popular perception of a general tendency in Japanese technology development to borrow concepts or

technologies initially developed elsewhere and then improve on them. These improvements are especially evident in commercialization steps beyond applied R&D: the Japanese excellence in processing and manufacturing was noted in all ten of the technical areas reviewed.

In several fields, however, researchers noted that there is currently a redirection toward a greater emphasis on basic research. This redirection marks a significant shift in Japanese research from the previously strong bias toward applied work. These fields include tribology, amorphous metals, and combustion.

Researchers in a variety of fields also noted some differences in the way research generally is conducted in Japan as compared with the U.S. It was noted that researchers in Japan are typically less restricted by academic disciplines than those in the U.S. In tribology, for example, a Japanese researcher will often apply to his research aspects of hydrodynamics, chemistry, and possibly even surface science, which are typically more differentiated disciplines in the U.S. Similarly, Japanese engineers in biotechnology will combine work in process engineering and fermentation in a more developed manner than U.S. researchers.

A second notable difference in research in Japan is the heavily empirical approach often used in finding a material or organism with desired characteristics. In biotechnology researchers observed that their Japanese counterparts will frequently screen hundreds of organisms to find one with the desired characteristics, rather than attempting to create one using genetic engineering techniques. Similarly, researchers in amorphous metals noted that their peers in Japan will often process a hundred different materials to derive rules of behavior and to find a material with the desired properties. This work is typically performed well and thoroughly but is very unlike the typical approach in the U.S., where researchers strongly prefer to work in areas that differ significantly from those of their peers.

The structure of research in Japan also appears to differ from that of the U.S. A substantial level of coordination of research efforts was noted by researchers in many of the fields studied. It was often remarked that although efforts in the U.S. are typically more broadly based than those in Japan, they

are also typically much less well coordinated. This level of coordination applies not only to the long-term efforts, but also to applied and developmental work. University-industry cooperation was also frequently mentioned as being much more significant in Japan. For example, in tribology it was noted that any university program lacking close industrial ties is considered to be a secondary program. Also, although the government financial contribution to research areas is recognized to be small to moderate, the coordination made possible by their guidance is viewed as significantly beneficial.

Researchers commented that both public and private agencies in Japan are more willing to commit resources to a research area over the long term and that this longer-term commitment fosters an ability to mix long-term and short-term efforts. Laboratories in Japan often do not distinguish between long-term and short-term work but perform the mixture of these elements that suits their technical needs. This commitment minimizes disruptions caused by changes in government administrations or by short-term fluctuations in private sector planning.

INFORMATION TRANSFER TO U.S. RESEARCHERS

The second major issue of concern addressed in this study is the quantity and quality of the technical information on Japanese research available to U.S. researchers. The researchers were asked about their methods for following developments in Japan as well as their judgments of the effectiveness of these means. In particular, researchers were asked to comment on the literature, conferences, and other mechanisms for interaction. In this section general comments on the various information sources are given first, followed by comments on a few specific technology areas. Finally, some overall concerns regarding information transfer are discussed.

Information Sources

Researchers commented that journals are the most useful and relevant in fundamental fields of study in which the state of the art advances slowly. Researchers in heat transfer and combustion noted that the two-year delay typical of journal articles does not often pose much difficulty. In the more end-use oriented fields, such as ceramics and amorphous metals, this two-year delay

can be the difference between the laboratory work and commercialization. In these sectors, researchers review the literature for the fundamental work but otherwise use it only as a supplementary source of information.

Major national or international conferences provide a good forum for interaction and are generally well attended by Japanese researchers. Conferences are typically viewed as being more timely than the journal literature. These conferences are also highly valued for their ability to provide contacts with researchers from Japan.

Smaller, more topically focused meetings often attract significant attendance from both the U.S. and Japan, such as the binational seminars sponsored by the National Science Foundation. Many researchers noted that these small seminars are among the most effective means of exchanging information because they provide an informal setting for interaction as well as an environment for technically detailed discussions.

The quality of these avenues for information transfer in each of the technology areas is summarized below.

Quality of Information Transfer in Various Technical Areas

Information dissemination in heat transfer is clearly superior to any other field covered in this study. In many ways, this field provides a model of information transfer that other fields would benefit from emulating. The field has good international journals and a service that translates selected articles from Japan. This service, which is published by Pergamon Press, screens articles written in Japanese and then translates them into English. This field also has conferences that are well attended by Japanese researchers and has periodic binational seminars. For example, the National Science Foundation has sponsored several binational seminars in heat transfer in the past few years.

A second set of technology areas is considered to have moderate information transfer from Japan. There are typically a few good international journals and a few good international conferences in these areas that combine to provide the primary formal sources of information on Japanese work. Fields

that fall into this category include amorphous metals, biotechnology, combustion, ceramics, and electrochemical energy storage.

The next lower step in the quality of information transfer involves those fields in which the international literature and conferences provide a sparse and incomplete picture of work in Japan. There are no major journals in these fields in which the Japanese regularly publish nor are there major conferences at which their work is well represented. These fields include biotechnology, heat engines and tribology.

Finally, in a few areas the information transfer is obviously poor. Neither the international literature nor the conferences provide more than very sparse coverage of work in Japan. These fields include high-temperature sensors and thermal and chemical energy storage. The incompleteness of the information transfer is reflected in the inability of U.S. researchers to identify notable aspects of Japanese research in these fields or to offer comments on Japan's comparative position.

Overall assessments of the quality of the information sources available in each of the fields are shown in Table 2. The assessment of the quality of the English language journals in the various fields is divided into U.S. and international journals, and Japanese journals or articles translated into English. An "excellent" rating indicates that generally researchers feel the material is comprehensive, sufficiently detailed, timely, and representative of the significant work under way. A "good" rating indicates that significant journals exist, but are lacking in timeliness, comprehensiveness, or in the detail of the research reported. "Fair" indicates that the journal coverage is very limited in comprehensiveness or detail on the Japanese work presented. Finally, a "poor" rating indicates that the material available is generally cursory, providing only very occasional information on developments in Japan. Conferences are rated in Table 2 on the same basis as the journals. Small meetings, which are generally regarded as being highly effective, are simply noted on the basis of how often they occur. An "excellent"-rated conference needs little improvement, and a "good" rating signifies that there are a few deficiencies detrimental to U.S. understanding of the material. The contribution of personal contacts to the information transfer process is not included

TABLE 2. Quality of Technical Information Transfer to U.S.

Research Field	Researcher Interviewed	Journals: International and United States	Journals: Japanese Translation	Conferences	Other Meetings	Overall Rating
Amorphous Metals	11	***	***	***	0	***
Ceramics	16	**	**	***	0	***
Combustion	15	***	**	***	0	***
Tribology	13	**	**	**	--	**
Heat Transfer	7	****	****	***	+	****
Biotechnology	6	**	**	**	0	**
Heat Engines	10	**	*	**	--	**
Electrochemical Energy Storage	9	***	**	***	0	***
Thermal and Chemical Energy Storage	6	*	*	*	--	*
High Temperature Sensors	8	*	*	*	--	*

**** excellent
*** good
** fair
* poor

\+ meetings occur periodically
0 meetings have occurred once or twice
-- no such meeting

in this overall rating. This is not to discount their importance, as many researchers use contacts as a primary means of monitoring developments in Japan, but they are omitted because access to this resource varies greatly among individuals and is not a generally available source.

Common Concerns Regarding Information Transfer

During the interviews, several common concerns arose regarding shortcomings in the transfer of technical information. These concerns centered on the quality of accessible technical information and the level of interaction with Japanese researchers. In all the fields, except for heat transfer, researchers have only very limited access to Japanese publications. The researchers contacted who are able to read or otherwise gain access to the Japanese technical literature found the information to be more useful than the international literature in several ways:

- The Japanese literature is more timely.
- The Japanese literature is often more detailed, describing experimental details often left out of the international literature.
- The Japanese literature does not duplicate material in international literature and offers useful additional insight to the work.
- The Japanese literature is more comprehensive than the international literature. Many researchers in Japan publish principally or solely in Japanese.
- The Japanese literature contains more information on applications of the research and on industrial research. The international literature is often principally academic.

Researchers also noted that the U.S. generally does a poor job of monitoring patents submitted in Japan. In contrast, there is an office in the Japanese government specifically assigned to monitor foreign patents.

Technical information services are not used very extensively because of the effort required to identify significant articles. Researchers in many fields noted that Japanese technical literature is not as thoroughly reviewed as U.S. technical literature. Consequently, the quality of the literature

varies widely, and sifting through the literature for the useful articles is frequently not considered to be worth the time required. Thus, translation of these articles alone is not sufficient. Researchers emphasized the need to provide screening service along with translation service, as performed in the field of heat transfer.

In addition to the inability to monitor much of the Japanese literature, it was frequently noted that relatively few U.S. researchers attend conferences in Japan or visit Japanese facilities. Again by contrast, Japanese technical people are very aggressive about attending U.S. conferences and visiting U.S. facilities. Therefore, visits of Japanese researchers to U.S. facilities are a major component of research interactions with the Japanese. U.S. researchers frequently noted that visiting research facilities in Japan has several advantages over relying upon Japanese visits to the U.S.:

- Visits allow detailed interchange about work underway at the facility in Japan.
- The facilities provide an indication of the approach and limitations of experiments in Japan, which are not always evident in the literature.
- The visits allow interaction with researchers in Japan who do not get to travel frequently to the U.S.

The importance of this personal interchange is suggested at two levels: formal exchanges and visits to research facilities and conferences in Japan.

A large percentage of the researchers interviewed recommend that exchanges be encouraged to give graduate students, faculty, and other members of the research community the opportunity to work in Japan. It was emphasized that these should be substantive scientific exchanges involving research in Japanese laboratories. In addition to developing an intimate familiarity with research methods used in Japan, these exchanges would have the more permanent benefit of allowing the development of close personal and professional contacts with researchers in Japan. Interviews have made it clear that the U.S. has been overly delinquent in promoting this type of exchange.

Many researchers also commented that visits to conferences in Japan and to research facilities should encouraged rather than restricted. Restricting travel only aggravates the problem of unidirectional information flow because few researchers are able to visit the experimental facilities in Japan to discuss technical details.

With the current restrictions on overseas travel imposed by many private organizations and the government, some researchers have relied heavily on the trip reports of those who do travel. While these trip reports can be valuable sources of information on current activities in Japan, they are limited by the researcher's interests and reasons for the visit. Trip reports also tend to be limited to the small group of researchers who are aware of them. No mechanism is available for making these reports known to the general community.

When discussing the need to encourage more visits to Japan, several caveats were offered by U.S. researchers who have had extensive experience in this area. These researchers noted that it is important to make a commitment to developing technical relationships: merely passing through facilities once may produce a very superficial view of the work. Secondly, it is important to develop an understanding of the structure of research in Japan. Researchers unaware of the differences, such as the organization of laboratories or the other facilities available, are likely to develop a distorted view of the work underway. Therefore, although visits are needed, the most meaningful rewards in information exchange are reaped through long-term contacts, which can only be developed by making a commitment to establishing and continuing technical relationships.

In summary, several steps can be taken to improve binational information transfer and provide both researchers and research managers with better insight into efforts in Japan. This study has revealed that in fields in which significant research is being performed in Japan, mechanisms of binational information exchange can be significantly improved. The principal components identified include:

- screening and translating technical material published in Japan

- promoting binational seminars or workshops, in conjunction with organizations such as the National Science Foundation
- encouraging the development of professional relationships through research exchanges and by easing international travel restrictions.

BENEFITS OF MONITORING JAPANESE RESEARCH: RESEARCH PLANNING

As international technology developments continue to advance, the inability of U.S. technology planners to utilize these developments will become increasingly significant. The potential penalties of not improving the current poor ability to keep abreast of R&D in Japan range from the inefficient repetition of R&D in the U.S. to the decreased competitiveness of U.S. industries.

By studying research overseas, both the researcher and research planner can increase the efficiency and effectiveness of their work. Researchers can benefit from international information exchange by exploring alternative insights that can be found overseas and by avoiding the repetition of costly experiments. Research planners can use information regarding international developments in their programmatic decisions, decisions that may bear directly upon the international competitiveness of U.S. technologies. This information would provide insight to the research planner regarding the comparative position and future developments in the field, and alternative emphases in technology development.

Comparative positions and future developments can be discerned by tracking R&D, since R&D is a predecessor of advances in commercial technology. For example, surface scientists note that the advanced semiconductor technology that has recently emerged in Japan was made possible by the significant long-term commitment made to this technology in the early 1970s. This commitment involved a heavy investment in surface science tools and their application to semiconductor materials at a notably more significant level than in the U.S.

Reviewing overseas activities can also shed light on alternative ways to organize the research approach in a technical field. For example, tribology research in Japan is conducted by intermixing chemical and mechanical components. By contrast, research in the U.S. tends to be conducted according to

more sharply defined disciplines, with a heavy emphasis on the mechanical aspects. A second example occurs in biotechnology, in which Japanese government-supported research focuses upon process engineering. By contrast, process engineering is a very minor part of the government-funded effort in the U.S.

Research managers are faced with the problem of acquiring a comprehensive understanding of binational research activities in the various fields. Sorting through the abundance of technical material would quickly become an unmanageable chore. Yet this study has demonstrated the importance of monitoring the comparative positions of U.S. and Japanese developments. Thus it is recommended that researchers who closely follow work in Japan meet periodically to share and summarize their perceptions of the status of Japanese R&D. These researchers could provide a valuable resource for a more comprehensive and technically detailed study of specific fields in Japan. Such studies are necessary to effectively understand the full extent, scope, and status of the potential challenge to U.S. research and technology development, and to ensure that U.S. research maintains its position at the leading edge of science and technology.

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July 8, 1985

The Honorable Douglas Walgren
The Subcommittee on Science, Research and
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2319 Rayburn House Office Building
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Dear Congressman Walgren,

You had requested in our recent conversation following the Subcommittee on Science, Research and Technology hearing on the Role of Technical Information in U.S. Competitiveness with Japan that I submit a letter for the record dealing with my past experiences relevant to the hearing. I will briefly summarize these points in the paragraphs below.

In the Spring of 1983, the Department of Commerce and Congressman Tim Wirth's Subcommittee on Telecommunications, Consumer Protection and Finance asked Technology Analysis Group, a telecommunications consulting firm, to put together a series of meetings on how to do business with Nippon Telegraph and Telephone Public Corporation. Despite the fact that these workshops were held all over the country and the fee for attendance was very low ($50.00 per person), there were surprisingly few attendees. The reason which the business community gave for not attending varied: the price was too high, it was a busy time of year, NTT would not buy American goods anyway, too little notice of when the meetings would be held, and so. Both the handout materials and the speeches given during the meetings addressed specifically the various aspects of how to do business with NTT, the largest purchaser of telecommunications equipment in Japan. Congressman Wirth and the Department of Commerce officials were disappointed with the turnout for the workshops.

During the following year Technology Analysis Group, in response to hearing many firms comment on the difficulty of doing business in Japan, held a number of seminars, e.g. "Software Business Opportunities in Japan" and "Interconnect Japan," on how to penetrate the non-NTT telecommunications market. The speakers were all experts on some aspect of doing business in Japan, some of them coming from Japan to take part in these meetings. Information on the seminars was sent to those who had attended the earlier workshops on how to do business

with NTT as well as to other major companies with products potentially marketable in Japan. Attendance at these seminars was very small; ranging from twelve to eighteen people. The cost for these meetings was high: $900.00. Yet those who attended frequently said that the information provided, including copious handout materials, was well worth the fee charged. Technology Analysis Group, however, was forced to discontinue these seminars due to the high costs for putting on the meetings and too low attendance.

My own personal experiences show that while American companies complain about the difficulties in doing business with the Japanese, they have been hesitant to hire people with expertise in Japanese language, culture, and business practices. I received a graduate degree in Japanese studies (including course work in these areas as well as its political system and history) in the mid-70's. Upon moving to Washington after completing my schooling, the only private or public groups, which expressed an interest in my skills, were the CIA and DIA. Since I did not wish to spend all my time doing translation, I looked for other opportunities. It has only been in recent years that I have been able to support myself by work which makes use of the background which I obtained during my graduate studies. Likewise, despite the fact that I am a woman, I still find that the Japanese, with whom I have contact, are more interested in and/or appreciative of my background than my American colleagues.

I hope the above information proves useful to the Subcommittee as it continues its efforts in this area.

Sincerely,

Patsy Vyner Hawks

Patsy Vyner Hawks
Senior Associate
Technology Analysis Group, Inc.

UNIVERSITY OF CALIFORNIA, SAN DIEGO

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CENTER FOR MAGNETIC RECORDING RESEARCH LA JOLLA, CALIFORNIA 92093

August 2, 1985

Mr. Dean Valuren
Committee on Science and Technology
2319 Rayburn House Office Building
Washington, D.C. 20515

Dear Mr. Valuren:

In response to an invitation from Ms. Fourliano, I am submitting this statement for the Record of the Hearings before the Subcommittee on Science, Research and Technology related to the availability of Japanese Scientific and Technical Information in the United States.

As Information Manager for a consortium of companies involved in an area of high technology, I have experienced at first hand the need felt by these companies to gain access to Japanese literature in their field. The Center for Magnetic Recording Research is a research consortium formed by thirteen companies and located at the University of California, San Diego campus.

A more fundamental problem than gaining access to a Japanese language document is the initial awareness that a document exists. Although most of the member companies in the consortium have well developed libraries, this problem remains. A library service can usually facilitate the process of obtaining a document once its existence is known. To do this a process must be established which tracks the emergence of relevant literature and facilitates the dissemination of that information to individual research scientists and engineers. In the past there appears to have been a naivete in the U.S. sci-tech community as to the amount of important information being published in Japan.

That there is a need is not now the question. The question is how to address that need.

In order to look at this vast resource of scientific and technical literature originating from Japan, I would suggest dividing it into the following categories:

(i) Commercially published material in English.
(ii) Commercially published material in Japanese.
(iii) Patent literature.
(iv) Non-commercial literature.

The first category presents the fewest problems. By commercial I refer to journal material published in Japan and available on a

subscription basis. Coverage of this material in the U.S. has improved markedly over the past few years. Much of it is being abstracted and indexed in English speaking countries by both profit and non-profit agencies.

The second category presents more of a problem. One can subscribe to this material although there is a paucity of U.S. vendors who will handle journal subscriptions which originate in Japan. Some journals include an English table of contents and an English abstract and many researchers rely on these. The quality of these abstracts is often uneven and can be misleadingly brief. However, many journals do not include any English, as their audience is primarily Japanese speaking.

Access to many of these publications can be gained through the Japan Information Center for Science and Technology (J.I.C.S.T.) database J.O.I.S. (Japan Online Information Service). However, at present, this database is in Japanese and requires a Japanese speaking search analyst to access it. This need not present a problem to those able to pay the high costs involved in accessing such a system and translating the results. Many smaller U.S. companies without large R&D budgets or the benefit of membership in a research consortium, are placed at a competitive disadvantage since they do not have access to this material.

The Japan Information Center for Science and Technology is interested in providing some English access to the database in the future since this would open up the large English speaking market to them. At this point, some profitable cooperative arrangements could possibly be forged between the U.S. and Japanese governments in this endeavor. A word of caution here involves timeliness. Once translation is involved the rate of entry of this material into the database could slow down. One can foresee that English language access terms may not be added to individual records for some time after publication. J.I.C.S.T. may find it is unable to allocate sufficient manpower to keep this process on a timely schedule. A cooperative effort with the U.S. could alleviate some problems in this area.

The third area, patent literature, is perhaps a little outside the scope of these hearings but should be mentioned if one is trying to gain a comprehensive view of Japanese scientific and technical information. The Japanese Patent database PATOLIS is a valuable source for such information, but again it is compiled in Japanese and thus presents a language problem. There are definite plans however to provide English language access to this database in the near future.

The final category is one which presents real problems. By non-commercial literature I refer to the technical report literature of Japanese companies, and research reports from government research institutions and universities. Conference proceedings, if unpublished, fall into this category also. Of course, coverage of this grey area of the literature is difficult even in our own country and much company report literature is never made available outside the originating company.

N.T.I.S. has directed considerable efforts towards this non-commercial literature of Japan and has managed to establish a number of agreements particularly with government and university research centers for exchange of such material. While N.T.I.S. has gained access to this material it has been unable to arrange or fund the translation of such material. Understandably, en masse this would be a daunting project and some material would be translated which would not be of interest to U.S. research and development efforts.

I am suggesting a cooperative arrangement whereby N.T.I.S. would play its role much as it has been doing - by seeking out and establishing arrangements to exchange documents of interest. Individual centers throughout the U.S., such as my own research consortium, private companies, universities, etc. could then gain access to documents in their own field of interest in the original Japanese from N.T.I.S. Each center would translate those of interest to them and then make the translated information available to N.T.I.S. possibly for inclusion into the N.T.I.S. database.

This procedure would eliminate unnecessary translation of unsuitable material since the selection would be made by experts in their own subject fields. N.T.I.S. could identify and target areas of the greatest potential interest to U.S. research and development efforts in both the public and private sectors. Participating centers would gain timely access to material which would be otherwise outside their acquisition scope. In return, N.T.I.S. would receive translated articles for wide dissemation to the U.S. scientific and technical community. Duplication of effort would be minimized and only areas targeted by N.T.I.S. need be covered initially. These targeted areas would necessarily be in those high technology areas where the U.S. stands to gain most from monitoring Japanese scientific and technical literature.

The above proposal is still embryonic and there are problem areas which would need resolving. However, I feel it has possibilities and thus submit it for consideration. I urge Congressional support for this or other suitable approaches which would enhance timely access to the Japanese Scientific and Technical literature. Should you require further elaboration of any of the areas I have discussed I would be happy to assist in any way I can.

Sincerely yours,

Dawn Talbot

Dawn Talbot, Manager
Information Center,
Center for Magnetic
Recording Research

NATIONAL SCIENCE FOUNDATION
WASHINGTON D.C. 20550

Directorate for Science and
Engineering Education

JUL 17 1985

July 16, 1985

Honorable Doug Walgren
House of Representatives
Washington, D.C. 20515

Dear Mr. Walgren:

This is in reply to your letter of June 27, 1985 to Mr. Erich Bloch regarding the graduate support activities of the American Electronics Association (AEA). Mr. Bloch has asked me to respond on his behalf.

The fellowship-loan program for doctoral study in engineering and computer science of AEA is quite familiar to me and it is, indeed, an excellent industry initiative to address the long range national need for excellence in teaching. The Foundation has been considering for some time how we might also respond in this area, and the experience and encouragement we have received from AEA has been helpful. At present, however, we have not decided how to proceed within our budgetary limits.

We greatly appreciate your interest in this matter, and will keep you informed of any new activities.

Sincerely yours,

Terence L. Porter
Director, Division of Research
Career Development

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June 27, 1985

Mr. Erich Bloch, Director
National Science Foundation
1800 G Street N.W., Room 520
Washington, D.C. 20550

Dear Mr. Bloch:

We were recently informed of a program sponsored by American Electronics Association (AEA) that addresses the serious problem of shortages of electrical and computer engineering and computer science faculty in the United States.

AEA is the largest trade association for electronics and information technology companies. It is helping major educational institutions attract top U.S. students for graduate study in computer and electrical engineering and computer science who want to teach, by providing tuition support and an annual living stipend. Companies fund these fellowship-loans through contributions to the AEA-sponsored Electronics Education Foundation.

The shortage of engineering and computer science faculty is getting worse, and it is already the major bottleneck to graduating the engineers and computer scientists needed to keep the U.S. economically competitive in the computer field. AEA's program has focused national attention on the financial need for doctoral fellowships in engineering and computer science in a direct and visible way by providing incentives for qualified American citizens to continue their computer studies rather than entering industry immediately upon graduation from college.

We believe AEA's Fellowship program is the type of effort that should be encouraged. It may act as a model for a government-university-industry partnership effort through NSF, serving a leadership role to the country. We urge your help by supporting development of such a program in any way possible.

Sincerely,

Doug Walgren, Chairman
Science, Research and
Technology Subcommittee

Sherwood Boehlert
Ranking Republican Member
Science, Research and
Technology Subcommittee

WB/Bcr

AUG 20 198

NATIONAL ACADEMY OF SCIENCES

2101 CONSTITUTION AVENUE WASHINGTON, D.C. 20418

OFFICE OF THE PRESIDENT

August 15, 1985

The Honorable Doug Walgren
The Honorable Sherwood Boehlert
Committee on Science and Technology
U.S. House of Representatives
Suite 2321, Rayburn House Office Building
Washington, D.C. 20515

Dear Mr. Walgren and Mr. Boehlert:

I am pleased to respond to your letter of July 26 in which you asked what the National Academy of Sciences is doing to promote U.S. access to Japanese technology. This letter will summarize our activities.

The Academy complex has organized in-depth studies of Japanese involvement in selected technical fields. Last year, an expert committee of the National Research Council published a study on High-Technology Ceramics in Japan, examining Japanese involvement in the growing ceramics field from both a technical and market perspective. Another Research Council committee is now studying international developments in computer sciences, and will analyze Japanese involvement in the field as part of its report. A report on "International Developments in Computer Science" published by a Research Council committee in 1982 outlined Japanese accomplishments in electronics and computer science and discussed the problem of U.S. scientists being unable to read technical publications written in Japanese and other foreign languages.

The National Academy of Sciences and the National Academy of Engineering also have been working to develop a mechanism for leaders of the industrial, university, and foreign policy communities of the United States and Japan to exchange views on issues pertaining to advanced technology and trade. On August 16-18, we will be holding

a gathering in California at which influential Japanese and American colleagues will discuss, informally and privately, important issues in this area. These nongovernmental discussions are intended to complement government activities by expanding the base of understanding needed to support wise policy-making. Dr. Harold Brown, Chairman of the Foreign Policy Institute, Johns Hopkins School of Advanced International Studies, will chair the discussions for the Academies. Subsequent outreach efforts are planned to inform a broad group of policy-makers in both countries.

In response to the specific areas listed in your letter, the Academy complex has no formal programs to encourage U.S. scientific and technical students to study the Japanese language or participate in exchange programs in Japan. Our current efforts to review and publicize Japanese technical literature are limited to the sectoral studies listed above.

I hope this brief review is helpful to you. Please do not hesitate to contact me if we can be of further assistance.

Yours sincerely,

Frank Press

Frank Press
President

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SUITE 2321 RAYBURN HOUSE OFFICE BUILDING
WASHINGTON, DC 20515
(202) 225-6371

July 26, 1985

Dr. Frank Press, President
National Academy of Sciences
2101 Constitution Avenue
Washington, D.C. 20418

Dear Dr. Press:

On June 26 and 27, 1985, the Subcommittee on Science, Research and Technology held hearings on "The Role of Technical Information in U.S. Competitiveness with Japan." A copy of the press release and witness list for those hearings is attached for your information.

In order to have as complete as possible a body of information on U.S. access to Japanese technology, we would appreciate a description of NAS activities related to that subject. A list of specific topics is also attached. In addition, any knowledge you have of similar activities on the part of your sister academies in other nations would be helpful.

Please contact Carol Pompliano (225-3433) or Maryanne Bach (225-8123) of the Subcommittee staff if you have any questions concerning this request.

Sincerely,

DOUG WALGREN, Chairman
Subcommittee on Science,
Research and Technology

SHERWOOD BOEHLERT
Ranking Republican Member
Subcommittee on Science,
Research and Technology

DW/cp

Enclosures

REQUEST FOR INFORMATION FOR HEARING RECORD

What activities related to U.S. acquisition of Japanese technical literature are funded, sponsored or otherwise encouraged by the National Academy of Sciences? Spcific areas of interest are:

1. Japanese language training programs, curricula and text books for science, engineering or other technical students.

2. Acquisition of Japanese technical literature originally published in English.

3. Acquisition and translation of technical literature published in Japanese.

4. Foreign exchange programs which place U.S. technical and scientific students, scientists or other technical personnel in Japan.

United States Department of State

Washington, D.C. 20520

AUG 20 1985

Dear Mr. Walgren:

In response to your letter of July 26, 1985 to Charles Horner, Deputy Assistant Secretary for Science and Technology, we are providing the following information for the House Committee on Science and Technology. The five questions in your letter are repeated with our responses to each.

1. (Q) How many State Department employees in the U.S. and Japan have as their major function the acquisition of Japanese scientific and technical information for dissemination in the United States?

(A) Eleven employees acquire scientific and technical information, but none has as his or her major function acquisition of such information.

Total for the State Department in Washington: Nine officers.

In addition there is a science counselor in the U.S. Embassy in Tokyo and a professional foreign service national employee with principal responsibility of working with the science counselor.

2. (Q) How many U.S. Government employees of other departments with scientific and technical backgrounds occupy office space in State Department facilities in Japan?

(A) Four U.S. Government employees, including two from the Department of Agriculture (with partial S&T responsibilities) and one each from the Department of Energy and the National Science Foundation occupy office space in the U.S. Embassy in Tokyo.

3. (Q) Does the United States have agreements with other countries for obtaining Japanese scientific and technical information?

The Honorable
Doug Walgren,
Chairman, Subcommittee on Science, Research
and Technology,
Committee on Science and Technology,
House of Representatives.

(A) The U.S. has no agreements with third countries to acquire such information. NTIS (National Technical Information Service, in the Department of Commerce) has an agreement with Japan's Information Center for Science and Technology (JICST) for acquisition of English-language abstracts of Japanese S&T articles.

4. (Q) Does the State Department engage in cooperative activities with other U.S. Government agencies or departments which result in the acquisition of Japanese technical literature for public dissemination in the U.S.?

(A) The State Department supports and facilitates acquisition of Japanese technical literature by any U.S. agency or department. For example, the Office of Scientific Affairs at the U.S. Embassy in Tokyo supported the agreement between NTIS and JICST which makes available Japanese S&T literature through libraries and computer data bases. The State Department has cooperated with seminars on the acquisition and dissemination of Japanese S&T information.

5. (Q) To what extent are the U.S. Chambers of Commerce in Japan, trade and professional associations, university and library groups, and private companies collecting such information that could be disseminated more widely within the U.S.?

(A) Speakers at a recent National Bureau of Standards (NBS) seminar on "U.S. Access to Japanese Technical Literature" (June 25 and 26, 1985), many of whom have also testified before the House Committee on Science and Technology, have provided details on this topic. In general, we believe that there is growing interest by these groups, particularly the engineering associations (for example, the Institute of Electrical and Electronics Engineers, which co-sponsored the NBS seminar), universities such as M.I.T., and companies such as IBM, AT&T, Burroughts and others.

I hope that this information will be helpful to you. If I can be of further assistance, please let me know.

With best wishes,

Sincerely,

William L. Ball, III
Assistant Secretary
Legislative and Intergovernmental Affairs

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SUITE 2321 RAYBURN HOUSE OFFICE BUILDING
WASHINGTON, DC 20515
(202) 225-6371

July 26, 1985

Mr. Charles Horner, Deputy Assistant
Secretary for Science & Technology
Department of State
2201 C Street, N.W.
Washington, D.C. 20520

Dear Mr. Horner:

Thank you again for participating in the recent hearings held by the Subcommittee on Science, Research and Technology on "The Role of Technical Information in U.S. Competitiveness With Japan."

In addition to your testimony, the Subcommittee would like to request some additional information for the record, as follows:

- How many State Department employees in the U.S. and Japan have as their major function the acquisition of Japanese scientific and technical information for dissemination in the United States?

- How many U.S. Government employees of other departments with scientific and technical backgrounds occupy office space in State Department facilities in Japan?

- Does the United States have agreements with other countries for obtaining Japanese scientific and technical information?

- Does the State Department engage in cooperative activities with other U.S. Government agencies or departments which result in the acquisition of Japanese technical literature for public dissemination in the U.S.?

- To what extent are the U.S. Chambers of Commerce in Japan, trade and professional associations, university and library groups, and private companies collecting such information that could be disseminated more widely within the United States?

Your cooperation in providing this information will greatly assist us in meeting the goals of the hearings. If you have any questions concerning this request, please contact Carol Pompliano (225-3433) or Maryanne Bach (225-8123) of the Subcommittee staff.

Sincerely,

DOUG WALGREN, Chairman
Subcommittee on Science,
Research and Technology

SHERWOOD BOEHLERT
Ranking Republican Member
Subcommittee on Science,
Research and Technology

WB/cp

SEP 30 1985

UNITED STATES DEPARTMENT OF EDUCATION

THE SECRETARY

SEP 24 1985

Honorable Doug Walgren
Chairman, Subcommittee on Science
Research and Technology
Committee on Science and Technology
House of Representatives
Washington, D.C. 20515

Dear Mr. Walgren:

Thank you for the letter requesting information from this Department concerning activities related to U.S. acquisition of Japanese technical literature that are funded or encouraged by this Department. An identical response is being sent to the Honorable Boehlert Sherwood.

Under the authorities of Title VI of the Higher Education Act of 1965 and Section 102(b)(6) of the Fulbright-Hays Act, this Department supports a variety of educational activities that include research and training both in the U.S. and abroad, individual and institutional, in the fields of foreign language, area and international studies.

Traditionally, support for these activities has focused on the need to train specialists in the humanities and social sciences. However, in recent years, the reauthorization of Title VI broadened the spectrum of Title VI activities and, following an evaluative study by the RAND Corporation, the participation of technical and professional schools and students in Title VI foreign language and area studies is being encouraged. While this change in emphasis is just beginning, it may very well result in significant participation by professional schools in foreign language and area studies. Hopefully, with the establishment of new priorities, an increasing number of professional school students will participate in related foreign language and area studies training.

The 13 USED-funded Title VI East Asian Studies centers all offer Japanese language and area studies instruction as do the East Asian programs receiving quotas of fellowships. A list of each is enclosed for your information.

Page 2 - Honorable Doug Walgren

We also administer other programs under the Fulbright authority which provide opportunities for U.S. academics to engage in research and training abroad, but this legislation is much more narrowly prescribed than Title VI and limited to foreign language and area studies. One project funded under this program is the Japanese Language Center in Tokyo which is a consortium of U.S. graduate schools administered by Stanford University and offers advanced, intensive Japanese language instruction to our most advanced and serious students.

If I can be of further assistance, please let me know.

Sincerely,

William J. Bennett

Enclosures

awards for MODERN FOREIGN LANGUAGE and AREA STUDY

The National Resource Centers and Fellowships Program, authorized by Title VI of the Higher Education Act, is administered by the U.S. Department of Education. The regulations and guidelines were published in the Federal Register on April 1, 1982.

Fellowships are available for advanced training in foreign language and area studies or international studies in selected programs at U.S. institutions of higher education. Approximately 650 graduate fellowships will be supported during academic year 1985-86 and 350 in the summer of 1986.

The institutions listed below have been allocated a quota of awards for 1985-86. Students should apply directly to these institutions and not to the Department of Education. Specific information on eligibility requirements and fellowship provisions can be obtained from the appropriate dean or financial aid officer at the university to which they apply.

AFRICA

Boston U.
U. Cal., Berkeley
UCLA
U. Florida
U. Illinois
Indiana U.
Michigan State U.
Northwestern U.
Stanford U.
U. Wisconsin
Yale U.

EAST ASIA

U. Cal., Berkeley
UCLA
U. Chicago
Columbia U.

Cornell U.
Harvard U.
U. Hawaii
U. Illinois
Indiana U.
U. Kansas
Michigan State U.
U. Michigan
Ohio State U.
U. Pennsylvania
U. Pittsburgh
Princeton U.
U. Southern Cal.
Stanford U.
U. Texas
U. Washington
U. Wisconsin
Yale U.

EAST EUROPE

Brown U.
U. Cal., Berkeley
UCLA
U. Chicago
Columbia U.
Cornell U.
Harvard U.
U. Illinois
Indiana U.

EAST EUROPE (Con't.)

U. Kansas
U. Michigan
Ohio State U.
U. Pennsylvania
U. Pittsburgh
Stanford U.
U. Virginia
U. Washington
U. Wisconsin
Yale U.

INNER ASIA (URALIC/ALTAIC)

Indiana U.

INTERNATIONAL STUDIES

UCLA
Columbia U.
U. Connecticut
~~U. Iowa~~
Johns Hopkins U. (SAIS)
Michigan State U.
U. Pennsylvania
U. Southern Cal.
Tufts U. (Fletcher)
U. Washington

LATIN AMERICA

U. Cal., Berkeley
UCLA
U. Cal., San Diego
U. Chicago
Columbia U.
U. Connecticut
Cornell U.
U. Florida
U. Illinois
Indiana U.
U. Kansas
U. New Mexico
New Mexico State U.
U. Pittsburgh
Stanford U.
U. Texas
Tulane U.
Vanderbilt U.
U. Wisconsin
Yale U.

MIDDLE EAST

U. Arizona
U. Cal., Berkeley
UCLA
U. Chicago
Columbia U.
Harvard U.
U. Michigan
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July 26, 1985

Hon. William J. Bennett
Secretary of Education
Department of Education
400 Maryland Avenue
Washington, DC 20202

Dear Mr. Bennett:

On June 26 and 27, 1985, the Subcommittee on Science, Research and Technology held hearings entitled, "The Role of Technical Information in U.S. Competitiveness with Japan." A copy of the press release and witness list for those hearings are attached for your information.

In order to address specific issues raised during the hearings, the Subcommittee requests that information be provided for the hearing record on those activities related to U.S. acquisition of Japanese technical literature that are funded, sponsored or otherwise encouraged by the Department of Education. It is our understanding that Richard T. Thompson, the Acting Director of the Center for International Education, recently participated in a seminar at the National Bureau of Standards on that subject area. Specific areas of interest include:

1. Japanese language training programs, curricula and text books geared towards science, engineering or other technical students.

2. Acquisition of Japanese technical literature originally published in English.

3. Acquisition and translation of technical literature published in Japan.

4. Foreign exchange programs which place U.S. technical and scientific students or educators in Japan.

5. Any programs which result in temporary or permanent assignment of Departmental employees to positions in Japan.

6. Cooperative activities related to Japanese technical literature which involve any other U.S. Government agency or department.

Hon. William J. Bennette
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July 26, 1985

In addition to the above, please provide any other pertinent information that you feel is appropriate for inclusion in the hearing record. If you have any questions concerning this request, please contact Carol Pompliano (225-3433) or Maryanne Bach (225-8123) of the Subcommittee staff.

Sincerely,

DOUG WALGREN, Chairman
Subcommittee on Science,
Research and Technology

SHERWOOD BOEHLERT
Ranking Republican Member
Subcommittee on Science,
Research and Technology

WB/Peg
Attachments

NATIONAL SCIENCE FOUNDATION
WASHINGTON D.C. 20550

August 29, 1985

OFFICE OF THE
ASSISTANT DIRECTOR
FOR ENGINEERING

Honorable Doug Walgren
U.S. House of Representatives
Washington, D.C. 20515

Dear Mr. Walgren:

Thank you for your letter of July 18 inquiring about what the NSF feels should be done to assist schools, colleges, and universities to develop appropriate curricula, etc., in technical Japanese.

While we and the rest of the research community are very interested in the topic of being able to read Japanese technical literature, the National Science Foundation has no activities in this area.

You might note that Professor Daub's course at the University of Wisconsin is unique in that it has a limited objective of enabling those who take it to read and understand Japanese technical literature. His course, however, does not lead to the ability to speak Japanese or to write Japanese. Researchers who only need the skills provided by this course will find it very useful. However, the commitment of time required to take even a course like this is very substantial and must result in the displacement of other topics in an already crowded curriculum.

The National Science Foundation is an interested bystander in this particular topic. Although we have no programs in this area, we are pleased to know of the existence of programs that enable researcher to be familiar with Japanese literature.

Sincerely yours,

Carl W. Hall

for Nam P. Suh
Assistant Director
for Engineering

Identical letter sent to:

Honorable Sherwood Boehlert

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Republican Staff Director

July 18, 1985

Dr. Erich Bloch
National Science Foundation
1800 G Street, NW
Washington, DC 20550

Dear Dr. Bloch:

Professor Edward Daub recently presented the enclosed testimony before the Subcommittee on Science, Research and Technology describing the program in technical Japanese which he has developed at the University of Wisconsin. None of the other witnesses disputed his assertion that his program is the only course in technical Japanese offered at an American university. We find this fact to be dismaying given the rapid emergence of Japan as a scientific, as well as a commercial competitor.

It is our belief that the U.S. must reach the point quickly as a nation where we have scientific and technical personnel in every discipline who have a reasonable understanding of Japanese scientific language and culture.

We are interested in learning what you feel the NSF and the Department of Education should be doing to assist schools, colleges, and universities to develop appropriate curricula, and to develop the educational infrastructure to permit programs such as Professor Daub's to proliferate.

We look forward to your response.

Sincerely,

DOUG WALGREN
Member of Congress

SHERWOOD BOEHLERT
Member of Congress

WB/Teg